TP 2182

SOUTHERN ONTARIO MULTIMODAL PASSENGER STUDIES

Transport Canada
Transports Canada

Ontario
Ministry of Transportation and Communications

TP 2182

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September 1979

TRANSPORT CANADA

MINISTRY OF TRANSPORTATION
AND COMMUNICATIONS, ONTARIO

Available in Canada through

Authorized Bookstore Agents
and other bookstores

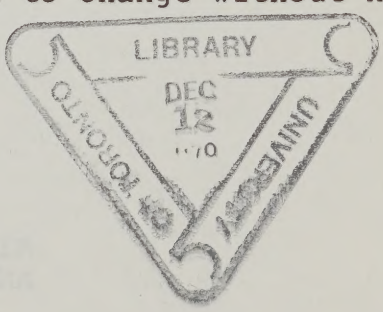
or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Hull, Quebec
Canada K1A 0S9

Catalogue No. T 53-7/1979
ISBN 0-660-10294-3

Canada: $2.00
Other countries: $2.40

Price subject to change without notice.



Cette publication est également disponible en français.

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ERRATA

In the TABLE OF CONTENTS:

page 2, APPENDICES C, delete "intercity".

page 2, LIST OF EXHIBITS 2, substitute "trip" with "trips".

page 2, LIST OF EXHIBITS 7, substitute "ratio" with "data".

page 3, LIST OF EXHIBITS 15, substitute "1968" with "1986".

In the text:

page 18, line 29, substitute "will assume" with "assumed".

page 78, line 18, substitute "a" with "as".

APPENDIX A, page 4, line 6, substitute "Crosswing" with "Crosswind".

APPENDIX B, page 4, redundant.

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1. EXECUTIVE SUMMARY

Background

Following the 1975 decision to defer the construction of a new airport at Pickering, the Federal Government embarked upon the Toronto International Airport Contingency Plan Study in an attempt to identify and evaluate suitable courses of action which would enable Toronto International Airport (Malton) to operate effectively until at least 1982. Arising out of the Contingency Plan Study, an Airside Improvement Program was developed.

In 1976, the Federal and Provincial Governments agreed to undertake a comprehensive multimodal review of intercity passenger transportation services in Southern Ontario, known as the Southern Ontario Multimodal Passenger Studies, with full consultation between the two parties. Special attention was to be given to the effects on air travel demand of recent shifts and future uncertainties in the economy, population growth and distribution, and to fiscal restraint. The potential of alternative modes of travel to relieve the pressure at Toronto International Airport was also to be considered.

In addition, the Federal Government has carried out a study to determine whether a third passenger terminal at Toronto International Airport would be a technically and operationally feasible option for provision of additional capacity in the short to medium term.

Report Content

This report describes the work and findings of the Southern Ontario Multimodal Passenger Studies, which co-ordinated information and findings from a number of related special purpose studies and carried out supplementary analysis where necessary to update data and to provide multimodal considerations.

Initially, the work undertaken covered all intercity travel modes. However, as the study progressed, it became evident, particularly after a review of the existing system, that the main focus of the work should be on the issues associated with Toronto International Airport capacity requirements. Consequently, evaluation of the other modes, rail, bus and automobile has been limited to an assessment of how these modes may contribute to the resolution of the airport issues.

Specifically, the study has dealt with the following elements:

- an inventory of the existing transportation system and its usage;
- estimation of a range of possible future travel demands;
- identification and preliminary evaluation of options for additional capacity to accommodate future travel demand;
- development of a logical process for making decisions as and when required with respect to timing and type of improvements necessary for accommodating travel at the present or a reduced level of service.

The report also indicates the current perspective on the urgency of decisions that will have to be made with respect to capacity improvements within the air mode and outlines the analytical work that must precede such decisions.

Findings and Conclusions

The findings from the Southern Ontario Multimodal Passenger Studies indicate that solutions to the anticipated short term airport capacity problem must be found primarily within the air sector. Improvements in passenger rail services will not be able or available to provide a sufficient and timely alternative solution to additional capacity requirements anticipated for Toronto International Airport in the early 1980's. Similarly the bus and automobile modes do not appear effective alternatives. There are in fact relatively few options available due to the required lead time for implementation of the major physical alternatives.

Furthermore, it is concluded that, due to a number of uncertainties facing the transportation sector, implementation of the options which have significant long range implications should be deferred as long as prudently possible, based on a continuous re-assessment of demands, system capabilities and appropriate levels of service.

Of particular importance is the conclusion that the existing runway system at Toronto International Airport will likely be adequate until at least the late 1980's, provided that a series of traffic management and procedural measures are successfully implemented and that access by general aviation is constrained. Additional terminal capacity must, however, be provided.

It is also a study conclusion that the lands at Pickering and the protective zoning of adjoining lands should be maintained to protect the long range option for the development of a major airport at Pickering.

Studies should be undertaken to investigate alternative locations for the general aviation sector. Such studies should assess the capability of existing airports as well as new locations, including the potential of the Pickering site.

The conclusions of the Southern Ontario Multimodal Passenger Studies are:

General

1. In the future a number of changes may take place which could have significant implications on the requirements for supply of transportation services. These include:

   - changes in economic growth;

   - changes in social and demographic structure within Canada;

   - changes in behaviour patterns relative to the changing economic, social, demographic, and environmental conditions;

   - changes in energy availability and price;

   - changes in transportation and communications technology;

   - changes in government regulation, operating costs and fares charged to the travelling public, with resultant changes in travel patterns.

This volatile environment indicates the limitations implicit in any long range forecasts of travel demand, as well as in the assessment of the capabilities of the existing transportation system and future modifications to this system.

2. In view of these uncertainties facing the transportation sector, definite long range commitments for transportation investments should not be made at this time. However, uncertainties always exist; therefore, at some stage long range investment decisions will have to be made. To accommodate these considerations, a decision process is being pursued to allow for:

   a) the deferral of decisions as long as prudently possible, and incremental improvement decisions to be made on the basis of assessment of both short and long term implications at each decision point;

   b) the adaptation to conditions as they prevail and uncertainties as they clarify over time, on the basis of continuous multimodal planning.

3. A specific range of annual air forecasts based on various socio-economic assumptions is required for further planning purposes at this point in time, and has been established. However, it should be noted that these forecasts do not yet reflect for the air mode the effect of promotional or incentive fares, and possible further regulatory changes.

4. While further analysis is necessary to establish the appropriate timing of major decisions and implementation of additional system capacity, requirements for response to capacity concerns within the air mode are more urgent than for other intercity modes.

Surface Modes

1. In general, the major proportion of the intercity road network currently has sufficient capacity between those centres which are the main generators of the domestic short-haul air traffic at Toronto International Airport.

Nevertheless, specific additional investments in these highway corridors are being made, and will be required in the future. Particularly in and around the main urban centres additional capacity will be necessary to accommodate the peaking of both commuting and weekend recreational travel. These travel sectors continue to put pressure on the existing highway infrastructure. Such investments will also benefit the longer distance intercity travel by both bus and automobile.

2. Because of the relatively small size and versatility of the intercity bus equipment, the bus operators can adjust the capacity of individual route services as demand varies by hour, week or season. The bus industry is likely, for the same reasons, to retain the capability of responding to growth in travel as it occurs.

3. Except for particular peak times of the year, passenger rail services currently operate with substantial spare capacity on the main routes.

4. The opportunity for passenger rail services to provide relief to Toronto International Airport is limited to the domestic short haul travel sector. However, even in this sector, measurable relief is primarily limited to the Toronto to Montreal and Ottawa market which currently accounts for about 13% of the total air passengers using terminal facilities at Toronto International Airport.

   Although improved passenger rail services in the Windsor-Quebec City corridor will result in increased intercity rail travel, simulation tests indicate that there is limited potential for a voluntary shift from air to rail on the Toronto-Montreal route, even with substantially increased rail speeds.

   The remaining air traffic sectors, long haul and international, are beyond the competitive reach of passenger rail services. Traffic growth in these sectors will alone, over time, trigger requirements for additional air facility investments.

5. While diversions from air to rail will not provide significant relief to Toronto International Airport in the short term, the extent to which the passenger rail mode might affect the requirements for investments in air facilities in the longer term must be further evaluated as this mode is developed. Developments to the rail system may include further marketing by VIA RAIL, introduction of new equipment and higher operating speeds.

6. Even if desirable, despite its cost, a very high speed passenger rail option (200-250 km/h or 125-150 mph average speed) is likely to require a lead time for full implementation of up to 12 years, at a cost of approximately $0.75-1.1 billion, and will not provide timely relief to Toronto International Airport for short to medium term capacity requirements.

Air

1. New forecasts indicate that air passenger volumes, on an annual basis in total will be lower than previously estimated. However, further detailing of the new forecasts with respect to the planning peak period conditions, and differences in growth between respective flight sectors, is needed in order to determine corresponding facility requirements. The impact of incentive fares, new domestic charter services and possible further regulatory changes will also have to be considered in further forecast refinements.

2. The Toronto International Airport site will likely be adequate for at least the next decade, contingent upon:

   a) successful implementation of appropriate recommendations from the Toronto International Airport Contingency Plan Study,

   b) continuous vigorous pursuit of operational efficiencies and demand management steps, and

   c) achievement of additional terminal capacity.

3. The first major decisions with respect to additional air system capacity, including a possible third terminal at Toronto International Airport (Malton) can be deferred 6-12 months. However, due to the lead time required for implementation, conceptual planning and definition of operational requirements for a third terminal should be undertaken now.

4. A major decision regarding the future of Toronto International Airport (T.I.A. Malton) and the Pickering site, other than possibly to proceed with a subsequent phase of a third terminal, will not be required before the early 1980's if additional terminal capacity sufficient to meet demand until the late 1980's can be achieved at T.I.A. This decision timing is premised on a required lead time for implementation of major facilities of about seven years.

5. Further planning work can and should proceed on STOL options, Hamilton Airport and London Airport. Although these will only provide limited relief to Toronto International Airport in the short term, they should be pursued on their own merits.

6. Studies should be undertaken to investigate alternative locations for the general aviation activities currently at Toronto International Airport. Such studies should assess the capability of existing sites as well as new locations, including the potential of the Pickering site.

7. In view of the economic and market uncertainties which will necessitate continuing modifications of the extent, form and timing of improvements to transportation facilities and services, the N.T.I.A. (Pickering) site should be retained as a long range option for a major airport.

2. INTRODUCTION

In recent years, transportation in Canada has been influenced by a changing economic climate; it has been affected by the slowdown in overall economic growth, the need to restrain government expenditures, and the increased cost of energy.

During the same period, changes have taken place within the transportation sector, partly as a result of the changing external influences and partly as a result of organizational, operational and technological developments within the respective transportation modes.

These changes include the establishment of VIA Rail Canada Inc. for planning and operation of passenger rail services, increasing use of higher capacity aircraft, development of quieter aircraft, introduction of incentive fares and gradual improvements in traffic control and traffic management techniques.

As a result, governments have been reconsidering specific transportation decisions and taking new initiatives to achieve objectives such as:

a) maximizing the use of existing transportation facilities,

b) restraining spending,

c) minimizing environmental impacts,

d) conserving energy, and

e) encouraging economic development.

The above objectives led governments to reconsider some specific decisions and to take new initiatives which are of particular importance for travel to, from and within Southern Ontario. Such initiatives, since 1975, have included the rationalization of passenger rail services, the decision to defer construction of a new major airport at Pickering and the review of measures necessary to extend the life of existing facilities at Toronto International Airport.

It is against this background that federal and Ontario transport officials agreed, in March 1976, to conduct a joint study of intercity passenger transportation requirements for Southern Ontario.

2.1 Objectives of Study and of This Report

The main objectives of the Southern Ontario Multimodal Passenger Studies (S.O.M.P.S.) have been:

a) to integrate the findings of related intercity passenger transportation studies,[1)]

b) to undertake additional investigations[2)] needed to develop a common data base acceptable to federal and provincial officials as a basis for future decisions, and

c) to develop, analyse and evaluate short and long range transportation alternatives which will consider the capability of all the major travel modes.

Previous studies, such as the Toronto International Airport Contingency Plan Study[3)], undertaken by Transport Canada, have indicated that the Toronto International Airport at Malton will eventually have insufficient capacity if air travel increases as previously forecast. Hence, the Southern Ontario Multimodal Passenger Studies have focussed on re-assessment of these forecasts and on the development of alternative responses to the anticipated shortages of capacity at Toronto International Airport. The studies have also examined the extent to which other modes, such as bus and rail, could be developed to attract and accommodate a portion of air travellers, thereby possibly deferring the requirement for expansion of facilities at Toronto International Airport or for developing an alternative airport site.

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1) See Appendix C

2) See Appendix B

3) Transport Canada, Air Transportation Administration Toronto International Airport Contingency Plan Study, September 1976 - October 1978.

The objectives of this report are:

(a) to summarize the findings of the various technical sub-studies,

(b) to describe a suggested planning and decision framework for addressing Toronto airport needs and associated roles for the surface modes, and

(c) to convey both tentative and definite conclusions reached during the study process.

It should be recognized that all analysis work is not yet complete. Nevertheless, this report summarizes the preliminary evaluation of the options studied and conveys a further understanding with respect to the priorities within the transportation system. It provides an updated perspective on the available alternatives and on the type and possible timing of strategic decisions required in the future. As such, the report lays the foundation for the detailed investigations that must precede such decisions.

2.2 Study Organization

2.2.1 Study Participants

The Southern Ontario Multimodal Passenger Studies have been carried out primarily by technical staff from Transport Canada and the Ontario Ministry of Transportation and Communications under the direction of a Federal/Provincial steering committee.

Since the major outstanding issue in intercity passenger transportation serving the Toronto hub is recognized to be that of the Toronto International Airport at Malton, the majority of sub-studies deal with the air mode. The various technical air mode studies were carried out by the staff of the Canadian Air Transportation Administration of Transport Canada, who subsequently conveyed their findings to the Southern Ontario Multimodal Passenger Studies for integration. A list of these air mode studies can be found in Appendix B, under "SOMATS[1] Reports".

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[1] SOMATS - Southern Ontario/Montreal Air Transportation Study: a series of technical studies on air transportation focussing on the Toronto airport system and the Montreal air hub, and carried out in conjunction with the Southern Ontario Multimodal Passenger Studies.

2.2.2 Study Scope

Initially, the study was undertaken to carry out a comprehensive review of all modes providing intercity passenger transportation within, from and to Southern Ontario including international travel.

However, as the work progressed it became clear that the main focus should be on the capability of Toronto International Airport to accommodate growing air travel, and consequently, on the future requirements for major airport facilities in the Toronto area.

The intercity transportation services examined in this work have therefore been only those modes and routes which serve the Toronto market or use Toronto as a transportation hub (Exhibit 1).

The surface modes, rail, bus and automobile, have been considered only with respect to how these modes may contribute to the relief of Toronto International Airport's anticipated shortage of capacity.

Urban and rural transportation have been considered only to the extent these sectors may affect the major issues that lie primarily within the air mode.

2.2.3 Study Program

The work program of the Southern Ontario Multimodal Passenger Studies has consisted of the following major steps:

a) the establishment of an inventory of data defining the multimodal intercity passenger transportation system serving Southern Ontario, and its usage;

b) the review and update of travel forecasts and of the underlying economic and demographic assumptions, as well as the use of alternative forecasting techniques;

c) the identification of a number of possible physical and operational improvements (supply strategies) in the provision of intercity passenger transportation services in Southern Ontario;

EXHIBIT 1

SOUTHERN ONTARIO
MAJOR INTERCITY TRANSPORTATION LINKS
(1978)

KEY

PASSENGER RAIL SERVICE

PRINCIPAL HIGHWAYS / BUS SERVICES

PRINCIPAL AIRPORTS

d) the analysis of the capacity of the passenger transportation system and of its components to accommodate future travel demand at the present level of service, in particular with regard to their likely contribution to the Toronto area airport issue;

e) the evaluation of possible physical and operational improvements (supply strategies) with respect to costs, capability and availability and a preliminary evaluation according to criteria such as impacts on users, environmental concerns, energy implications and flexibility to accommodate future uncertainties;

f) the development of recommendations concerning the most appropriate sequence and procedure for decisions and implementation of transportation system improvements.

3. EXISTING INTERCITY PASSENGER TRANSPORTATION IN SOUTHERN ONTARIO

3.1 Introduction

One of the tasks of the Southern Ontario Multimodal Passenger Studies has been to assemble a transportation information base relevant to the study issues.

The information collected has been drawn from a variety of available sources such as surveys and statistical files within the transportation industry and governments.

This chapter is divided into two sections. The first (Section 3.2) deals with travel within Southern Ontario, and for study purposes includes Montreal. The second section (Section 3.3) deals with travel to and from Southern Ontario.

3.2 Passenger Transportation Within Southern Ontario

3.2.1 Modal Shares

Intercity travel within Southern Ontario generally consists of trips shorter than 500 miles. The transportation system in this region is multimodal, i.e. travel by air, rail, bus and auto is possible between most major centres (Exhibits 2 and 3). The automobile is the primary mode in all markets, and its share is greatest on shorter journeys, such as Toronto-London (83%). Air has a significant share of the market on longer trips within the region, such as Toronto-Ottawa (26%). Between the six major centres listed in Exhibit 2, air has on an average 18% of the total market.

The public surface modes (rail and bus) carry on the average less than 20% of the total travel between Toronto and the same cities. Rail has a larger share than bus in the prime Montreal-Windsor corridor, but a lower share than bus on others such as Toronto-Ottawa and Toronto-Sudbury.

While Toronto-Ottawa-Montreal travel by air is only about 13% of all air travel at Toronto International Airport, it represents about 23% of all aircraft movements. Furthermore, it constitutes 75% (approximately 1.4 million passengers in 1977) of all short-haul air travel from and to Toronto. This concentration of domestic short-haul air travel into two city pairs makes this market the most important when considering the divertability of air travel to other modes as a potential means to resolve the airport issue.

EXHIBIT 2

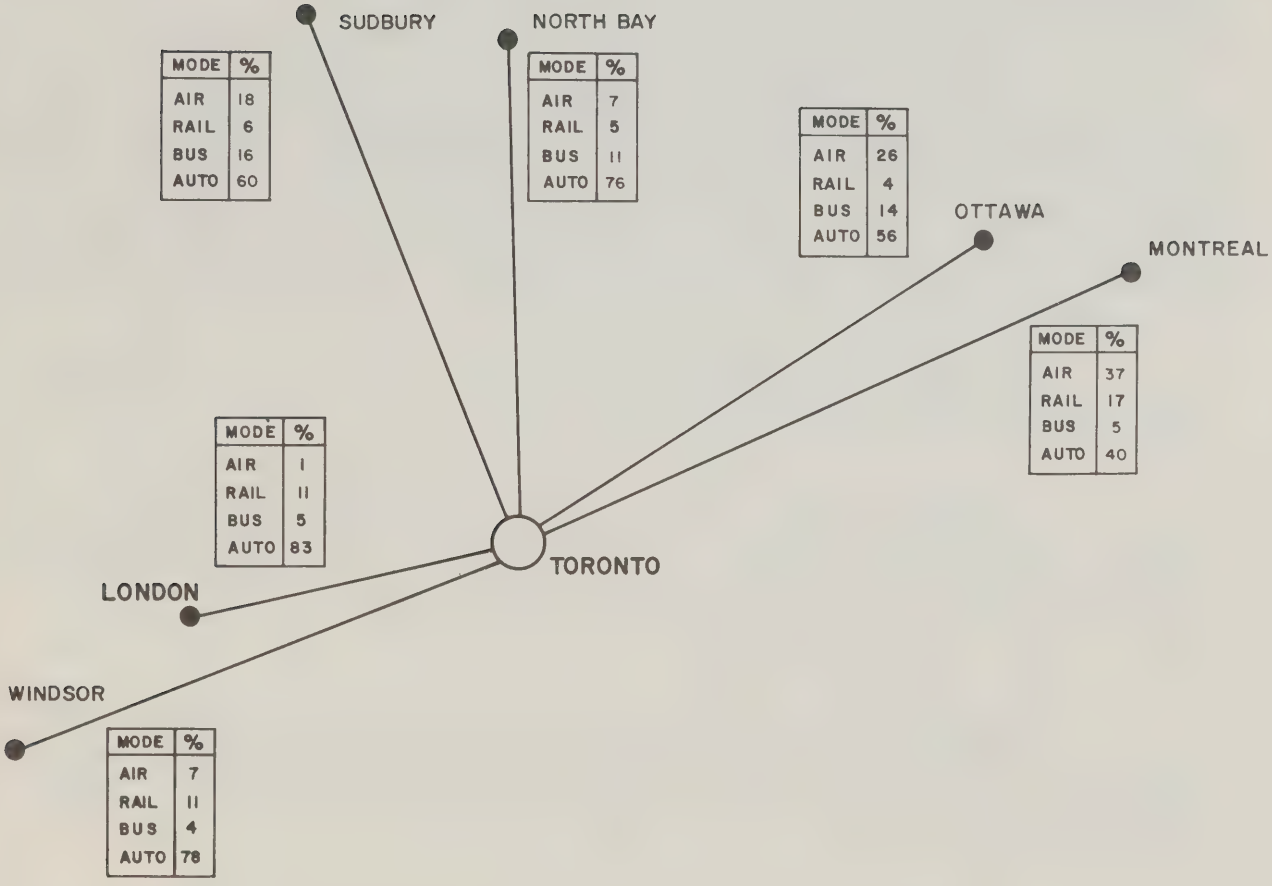
ANNUAL PERSON TRIPS BY MODE BETWEEN TORONTO AND 6 URBAN CENTRES 1976

CITY PAIR	TRIPS ('000'S)				
	AIR	RAIL	BUS	AUTO	TOTAL
TORONTO - MONTREAL	992	454	130	1070	2646
TORONTO - OTTAWA	501	76	245	1100	1922
TORONTO - LONDON	30	293	135	2141	2599
TORONTO - WINDSOR / DETROIT	150	231	88	1620	2089
TORONTO - SUDBURY	90	31	79	300	500
TORONTO - NORTH BAY	26	20	41	280	367
TOTAL TORONTO	1789	1105	718	6511	10123
MARKET SHARE (%)	18	11	7	64	100

SOURCE : VARIOUS CARRIER AND OFFICIAL STATISTICS.

EXHIBIT 3

MODAL SHARE OF INTERCITY TRAVEL FOR 6 CITY PAIRS 1976



3.2.2 Historical Perspective

A review of Southern Ontario travel in the past helps to indicate potential trends in the near future.

Exhibit 4 shows the changes in air passenger volumes for the Toronto-Ottawa/Montreal links from 1970 to 1978. The combined travel volume has remained fairly constant since 1974. During the same period, air fares have been substantially increased on such short haul routes, primarily in order to eliminate airline internal cross-subsidization. This, in combination with slow economic growth may have contributed to the relatively low growth rate of domestic short-haul air travel between 1974 and 1978.

Trends in rail ridership in the same period have varied by route. Exhibit 5A shows rail passenger volumes for selected city pairs in the Quebec City-Windsor corridor from 1974 to 1978. The growth observed on most routes has occurred without significant service improvements in equipment and travel times. During 1978, considerable promotional efforts were made. However, rail fares continued to be subsidized at an increasing rate (Section 3.2.4).

Exhibit 5B shows bus passenger volumes on express services between Toronto, Montreal and Ottawa from 1974 to 1978.

Automobile has shown small but steady increases in usage. As shown in Exhibit 6, automobile traffic increases are greatest around the major urban centres, not between centres. This trend is expected to continue.

3.2.3 User Characteristics

Short-distance domestic air travellers differ from users of other modes in that their primary trip purpose is business. The other modes (rail, bus and auto) serve a larger proportion of personal trip purposes, such as visiting friends and relatives.

Both bus and rail attract a considerable portion of people such as students and senior citizens[1] to whom the cost of travel is most important. Both modes also offer an extensive range of incentive fares for short haul travel.

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(1) On a national basis, 40% of all bus person-trips are made by people who are not in the labour force. Transport Canada, Strategic Planning Group, Report on June 1977 Travel Survey, November 1978, p. 44.

EXHIBIT 4

DOMESTIC SHORT HAUL AIR TRAVEL
1970 - 1978
FOR 2 CITY PAIRS
(ORIGIN – DESTINATION PASSENGERS IN MILLIONS)

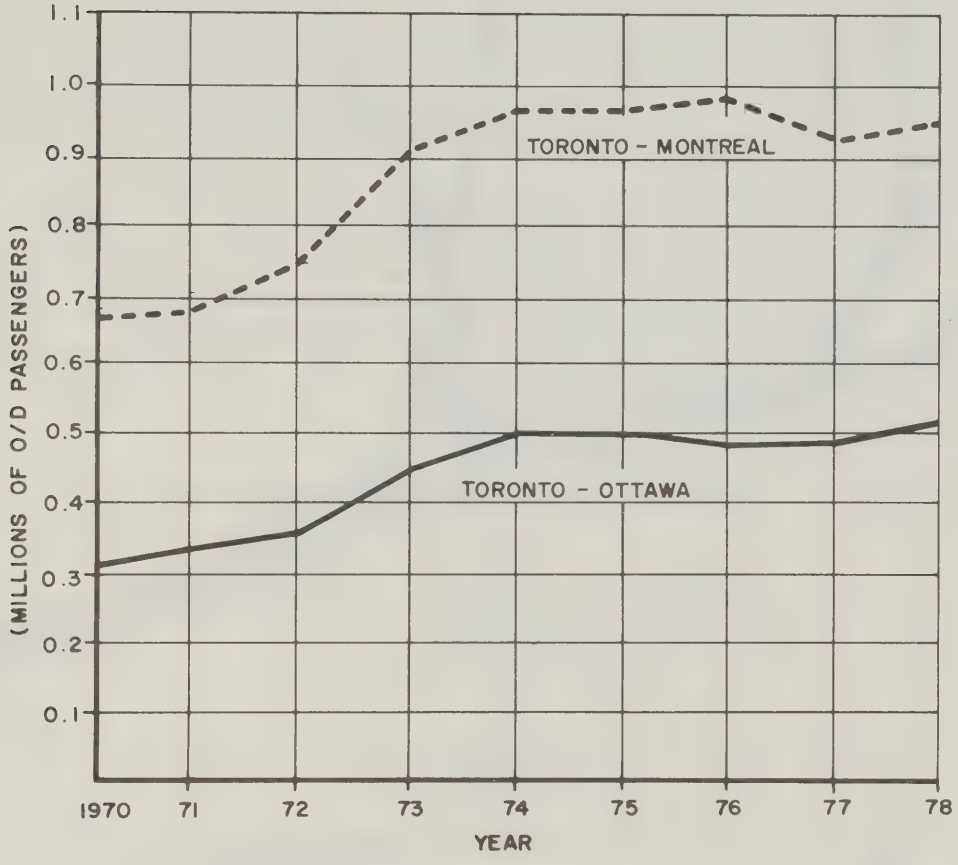
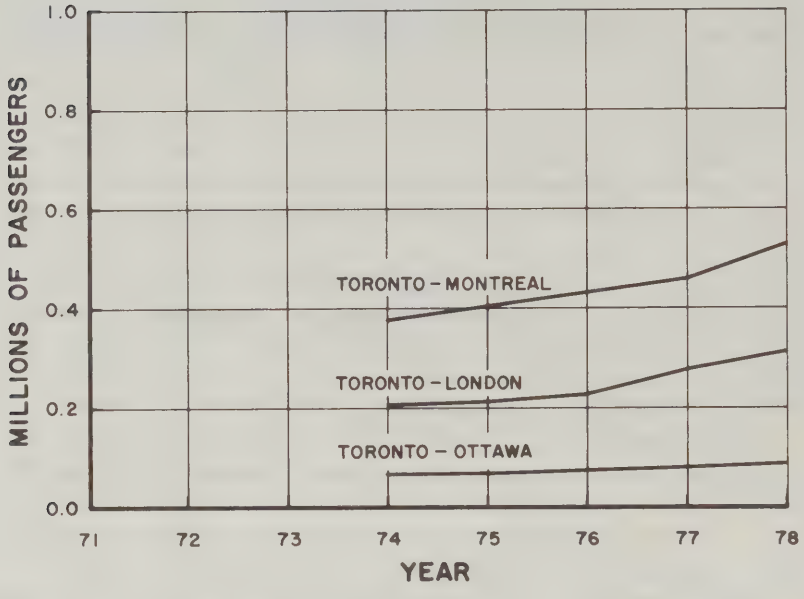


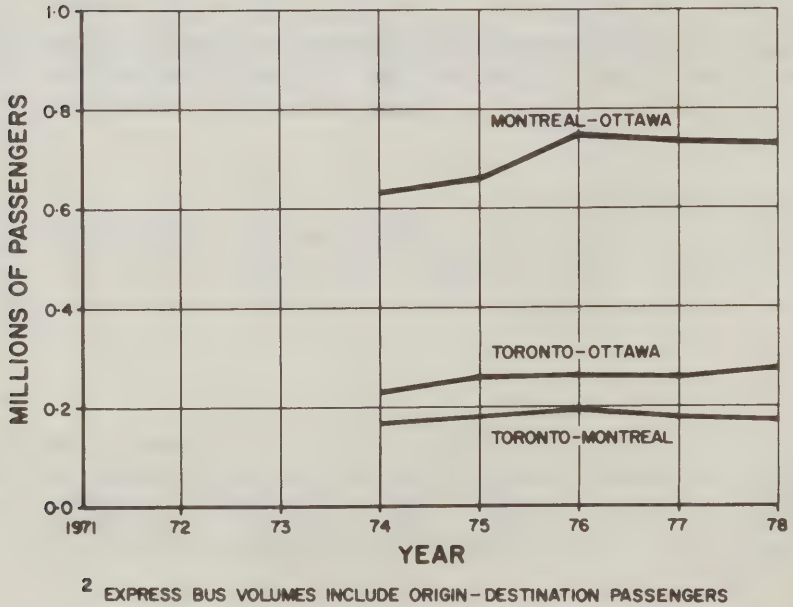
EXHIBIT 5

5A RAIL REVENUE PASSENGER VOLUMES
FOR SELECTED CITY PAIRS
1974 – 1978[1]



[1] 1978 IS ESTIMATED.
INCLUDES ONLY TRIPS MADE BETWEEN THE SPECIFIC CITY PAIRS

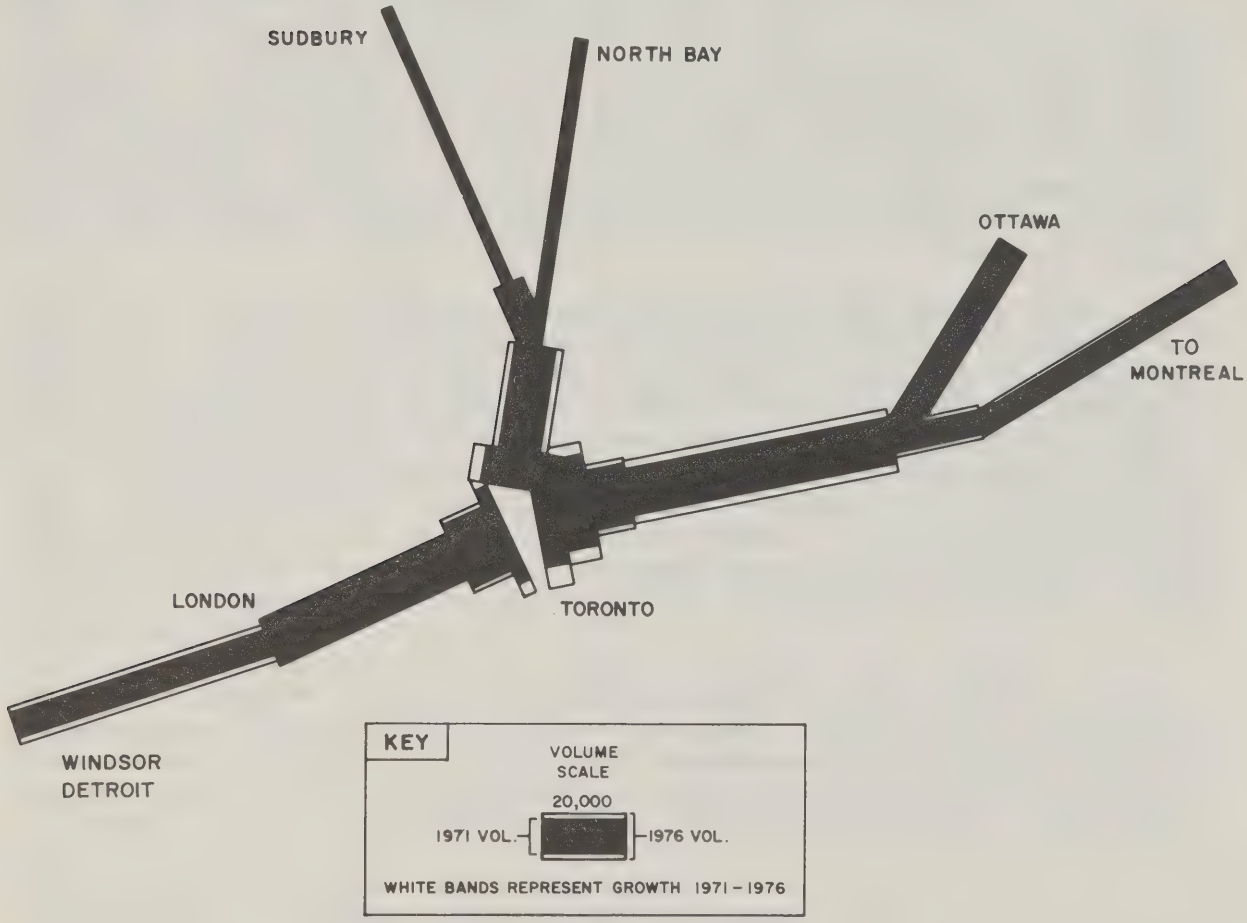
5B EXPRESS BUS PASSENGER VOLUMES
1974-1978
FOR 3 CITY PAIRS[2]



[2] EXPRESS BUS VOLUMES INCLUDE ORIGIN–DESTINATION PASSENGERS PLUS THOSE TRAVELING THE ENTIRE ROUTE AND CONNECTING AT THE END POINTS FOR OTHER DESTINATIONS

EXHIBIT 6

GROWTH IN AUTO USAGE
1971 VS 1976
AVERAGE ANNUAL DAILY HIGHWAY TRAFFIC



3.2.4 Present System Conditions and Issues

Automobile

The automobile mode is accommodated, with truck and bus transportation, on an extensive network of municipal and provincial roads. Most major cities within and near Southern Ontario are linked by four lane divided highways, ensuring generally safe and reliable high capacity, year round service. In general, the major portion of the intercity road network has currently sufficient capacity between those centres which are the main generators of the domestic short haul air and intercity rail traffic.

There are no technological changes on the horizon which would suggest that a high standard year-round highway system of adequate capacity will not be needed in the foreseeable future. The reliance on trucks and automobiles for the transportation of goods and people will continue and will require substantial expenditures for both maintenance and upgrading of the roads. Annually updated inventories of road conditions provide a basis for determining the maintenance and improvements necessary to maintain appropriate standards for level of service and physical quality of the roads.

Additional highway capacity will be required in the future, particularly to accommodate growth of travel in and around the main urban centres where the growth of highly peaked commuting and week-end recreational travel will put increasing pressure on existing highways. Intercity travel will also benefit from these improvements.

Thus, it can be concluded that the committed and planned road network will be able to accommodate the normal growth of intercity automobile travel, as well as possible additional auto travel that may occur if shifts from other intercity modes are experienced in the future.

Bus

Buses share the existing Southern Ontario highway system with automobiles and trucks. There is an extensive network of intercity bus routes which provides transportation within and across the boundaries of the study region.

The bus system is operated by a number of private and publicly-owned companies holding operating licenses issued by the Provincial Government for specific routes. The companies receive no operating subsidies.

On the main routes, bus is in competition with rail, usually offering comparable fares and higher frequencies.

On the relevant routes, bus companies generally use modern air-conditioned and washroom-equipped coaches. In recent years, several luxury type services have been introduced. These services offer express transportation, low density seating and hostess service resulting in shorter travel times and greater passenger comfort. A premium fare is charged for this luxury service.

A significant feature of the bus system is that, in addition to direct intercity services which parallel those of the rail system, buses provide transportation between smaller centres along these routes as well as transportation between centres not on these routes. This local and regional transportation is an important market for bus. Moreover, this local transportation service is generally not provided by other public modes. In order to provide continued service on local routes, bus companies, in some cases, use part of the surpluses from their more profitable routes and services such as express buses and parcel services, to offset losses.

One of the main advantages of the bus mode is its flexibility in terms of both routes and passenger capacity. This enables the bus industry to respond quickly to changes in the number of customers wanting transportation between centers presently served as well as to new destinations. Between major city pairs, for example, extra buses are frequently provided to accommodate any passengers in excess of the capacity of normally scheduled equipment.

The bus services are operated over municipal and provincial roads, and as such are subject to posted speed limits and any congestion that occurs on these facilities. As mentioned previously, the major intercity portions of the highways operate with sufficient capacity and, with committed and planned improvements, they are expected to do so for the foreseeable future, thus providing no major constraints to bus travel. However, near the major urban centres, increasing congestion during peak commuting hours may lengthen intercity bus travel times, depending on the location of terminals.

It can be concluded that the bus industry will retain the capability of accommodating, in an effective manner, the future increase in travel that may arise from natural growth and from any additional traffic that may occur as a result of shifts from other intercity modes, for example, if capacity constraints or fuel restraints were experienced in these other modes.

Rail

Exhibit 7 shows financial and related operating data for eleven corridor routes[1] from 1972 to 1977, as well as number of passenger miles and revenue passengers. Over the 5 year period, the total number of passenger miles increased on these routes by 2.3%, although the number of passengers decreased by 6.6%. Since 1975, however, both of these statistics have been growing at about 6% per annum, and preliminary indications are that there was a further improvement in 1978.

In spite of increases in the amount of rail travel, costs have risen faster than revenues, resulting in a continued escalation of losses. The deficit incurred by operation of corridor rail passenger services has increased from $22.5 million in 1972 to $66.8 million in 1977, and in 1978 an estimated $68.2 million for the eleven corridor routes. Cost increases are due to many factors including higher labour costs, higher fuel prices, poor equipment utilization, increase in service frequency, and higher maintenance and overhead costs. As an example, for the Montreal-Toronto service, which accounts for 45% of the rail passenger miles in the corridor, and is the most efficient service in the system in terms of equipment utilization, load factor (currently 50%) and financial performance, the loss per passenger-mile more than tripled from 2.5 cents to 8.2 cents over the period, while the loss per seat-mile rose from 1.4 cents to 4.1 cents.

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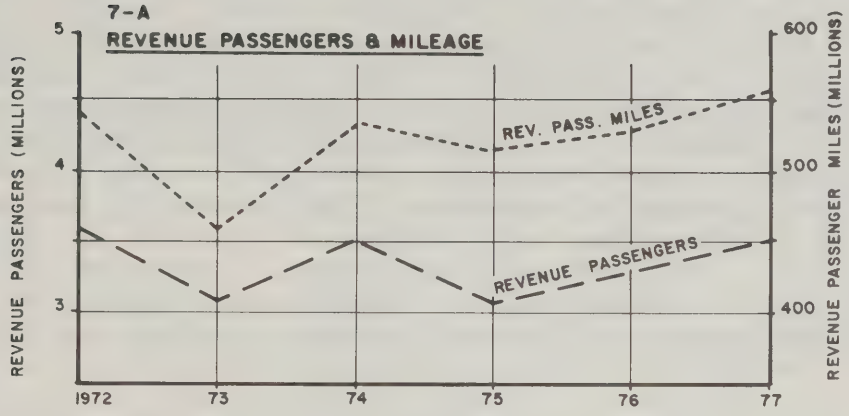
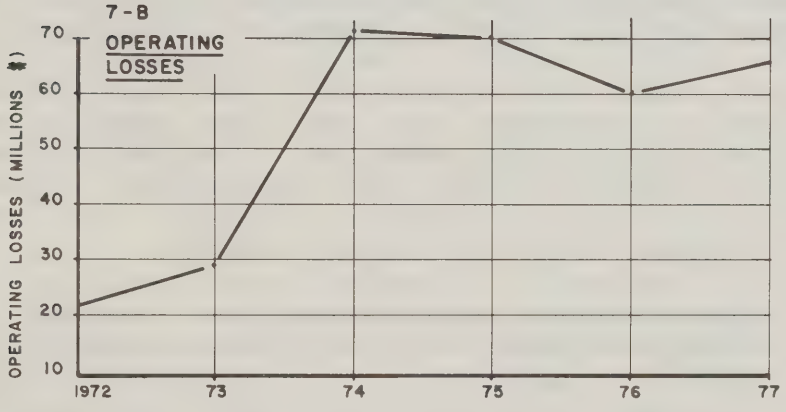
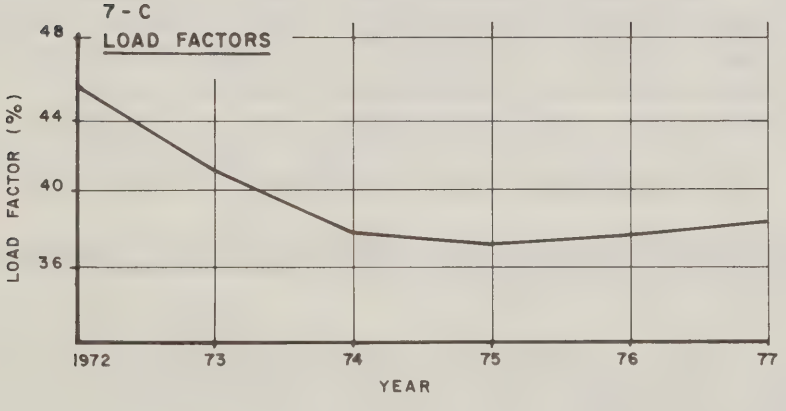
[1] These eleven routes are: Montreal-Toronto, Toronto-Kingston, Montreal-Quebec CN, Montreal-Quebec CP, Montreal-Ottawa, Ottawa-Brockville-Toronto, Ottawa-Belleville (Toronto), Toronto-Windsor, Toronto-London-Sarnia, Toronto-Stratford and Toronto-Niagara Falls.

EXHIBIT 7

CORRIDOR RAIL PASSENGER SERVICES
FINANCIAL & RELATED OPERATING DATA 1972-1977
(11 CORRIDOR ROUTES)







Equipment in corridor service consists of the newer Turbo train (operating at 120 km/h (75 mph) average speeds), the Tempo trains, the older Rapido trains, self propelled coaches and conventional trains. The amount of equipment presently used in the corridor is well above that required for efficient operation as indicated by the low load factor shown in Exhibit 7. However, corridor service improvements require the development of more attractive and efficient conventional trains and self propelled coaches. VIA presently has underway a program of refurbishing self propelled coaches and existing train interiors. The Federal government, together with VIA Rail Canada Inc., has ordered 10 higher speed train sets. Some of the new equipment will be used in the Quebec City-Windsor corridor.

Higher speeds will impose the need for investments in safety, specifically for grade-separation of highway crossings, improved track and automated traffic control systems.

Currently, passenger rail services must share the same track system with freight services. Freight train movements with their differing speed and performance characteristics could be an obstacle to improved speeds for passenger services. This aspect requires further study.

The mandate of VIA Rail Canada Inc. is to provide efficient and attractive service, to increase patronage, and to reduce the level of subsidies. VIA has been in charge of marketing rail passenger services since 1977, and will assume full control over all services in April 1979. VIA has predicted that deficit reductions are possible while simultaneously increasing patronage at the rate of 7-1/2% per year, over the next 5 years. This is based on the average growth in the corridor over the last 2 years.

VIA is planning the following improvements in the Windsor-Quebec City corridor and elsewhere in the system:

- development and introduction of improved equipment more suited to market needs,

- specifying train sizes and frequencies more closely matched to the actual volume of passengers, thereby increasing the load factors and reducing the costs per passenger mile,

- improving the utilization of equipment,
- continuing marketing and market analysis to increase patronage and the rail share of the market,
- improving the reservation systems,
- undertaking technical studies to identify improvements in the corridor routes,
- undertaking construction for corridor route improvements.

It can be concluded that, except for particular peak times of the year, passenger rail service will have the capability of accommodating the future increases in travel that may arise from natural growth. However, in spite of recent increases in rail ridership, the operating loss (and hence the subsidy) has been continually increasing. VIA Rail is planning to make changes with the objective of increased ridership and reduced losses. The federal government has directed VIA Rail to take into account the impact of these changes on other modes.

Air

Airport facilities in Southern Ontario handle various types of traffic, ranging from regional air services to national, transborder and international traffic. At Toronto International Airport, 23% of all trips with origin or destination in Toronto are to or from places in Canada within a radius of 500 miles (short haul domestic trips, Exhibit 8A) and remain generally within the study region. The remaining 77% of the trips are to points beyond the Southern Ontario region. Because of this dominance of extra-regional and long-haul travel in the air mode, present system conditions must be assessed in the context of all air sectors and will be dealt with in the next section.

3.3 Passenger Transportation to and from Southern Ontario

3.3.1 Current Demand

Except for travel to particular destinations close to the Southern Ontario region, the transportation system for journeys to or from the Southern Ontario region is dominated by the air mode. Air transportation is the preferred mode in

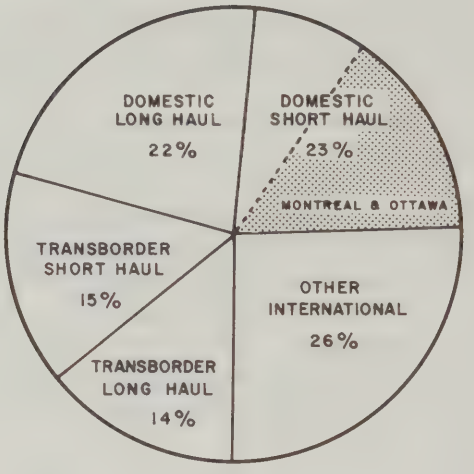
EXHIBIT 8

AIR PASSENGER TRAVEL BY AIR SEGMENT FOR 1977 TORONTO INTERNATIONAL AIRPORT

8 A.

ORIGIN DESTINATION PASSENGER TRIPS

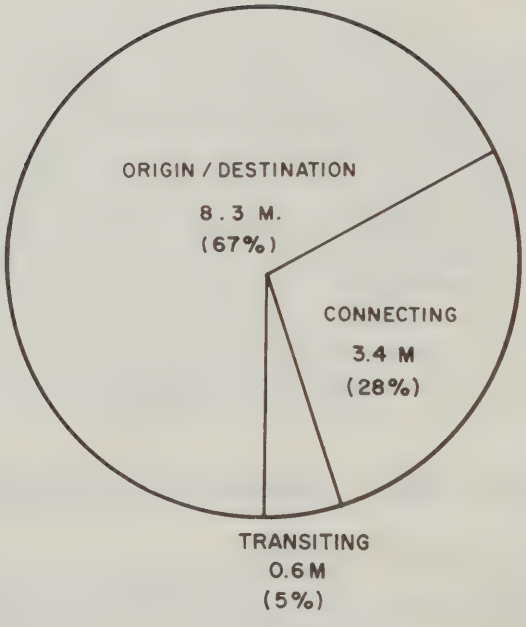
8,300,000



8 B.

TOTAL AIR PASSENGER TRIPS

12,300,000



long-distance travel mainly because of its superior travel time. Generally, the more distant a destination the more travellers tend to choose the air mode over the otherwise dominant auto-mode[1]. While the automobile continues to be used, for example for many long-distance vacation trips on the continent (because of its versatility and perceived low cost), the ground modes including the automobile appear to have only limited potential for diverting travellers from the air mode. In overseas travel, the air mode has virtually a monopoly position.[2]

Toronto International Airport (T.I.A.) is the major hub for air travel from and to Southern Ontario. In 1977, it handled 12.3 million passengers (Exhibit 8B) of which:

- 8.3 million passengers had their origin or final destination in the Toronto region,
- 3.4 million passengers made connections with other flights, and
- 0.6 million were passengers who were arriving and leaving on the same aircraft (transiting passengers).

The 4.0 million passengers (32.5% of all air trips at Toronto International Airport) who are either connecting to another aircraft or passing through the airport without disembarking have primarily an impact on the airside of the airport (runways, taxiways, air traffic control system , etc.) and, in the case of connecting passengers, also on terminal facilities. The 8.3 million passengers who have their origin or destination in the Toronto region utilize the airport ground access system (roads, parking facilities, buses, etc.) in addition to terminals and airside facilities.

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1 Transport Canada, Report on June 1977 Travel Survey, November 1978, p. 73.

2 International Civil Aviation Organization (ICAO), Study of Air Passenger & Freight Transportation in North America, Working Paper, AT-WP1222, March 1976, p. 1.15.

In 1977, the trips with either origin or final destination in Toronto had the following composition (Exhibit 8A):

- Domestic travel (long and short haul): 45%
- International and Transborder travel: 55%

75% of domestic short haul traffic at Toronto International Airport was from and to Montreal and Ottawa.

3.3.2 Historical Perspective

Exhibit 9 shows the growth pattern for the travel that has either origin or final destination in the Toronto area. The use of Toronto International Airport increased very significantly in the 1971-74 period (averaging 18% per annum). However, since 1974, total growth has slowed down to about 2% per annum. In the domestic sector, travel has remained relatively constant since 1974. The international and transborder sectors, in particular travel to the southern U.S.A. and other international "sunspot" markets, have shown a faster growth than the other air sectors. Travel to and from southern destinations peaks during the winter months. Since the peaking patterns throughout the day of north-south travel differ from those of transatlantic travel, different and perhaps improved utilization of facilities and resources will take place compared to past experience when transatlantic travel was the strongest growth sector.

Travel statistics show that the air travel market has been subject to sudden changes in growth on a year to year basis. These annual variations in air travel demand appear to bear a close relationship to the performance of the economy, both on a provincial and national basis. The likelihood of similar variations occurring in the future should be borne in mind when assessing the various forecasts and supply options.

Annual mainline scheduled aircraft movements at Toronto International Airport increased until 1974 as shown in Exhibit 10. Since that year, there has been a slight reduction in the number of scheduled aircraft movements. This is partly a result of higher load factors and changing aircraft fleet composition combined with a lack of growth in domestic travel. The decline in scheduled aircraft movements combined with the increase in total passenger volumes has resulted in greater pressure being applied to the available capacity of the passenger terminal buildings than to the runways.

EXHIBIT 9

AIR PASSENGER TRAVEL AT TORONTO INTERNATIONAL AIRPORT 1963 – 1977

(ORIGIN DESTINATION PASSENGERS)

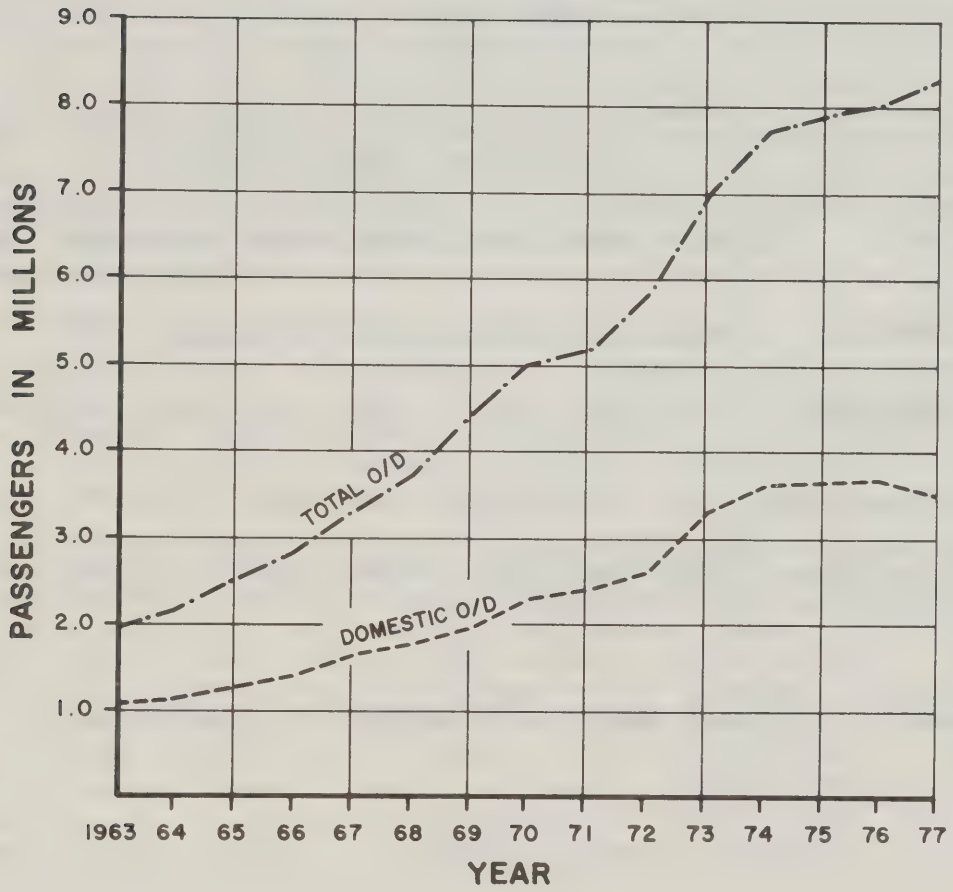

EXHIBIT 10

MAINLINE ANNUAL DOMESTIC AND INTERNATIONAL SCHEDULED FLIGHTS AT TORONTO INTERNATIONAL AIRPORT

(IN THOUSANDS)

1970 - 1977

FLIGHT SECTOR	Nº OF FLIGHTS (000's)							
	1970	1971	1972	1973	1974	1975	1976	1977
DOMESTIC	62.0	65.8	67.5	75.6	84.1	81.7	78.3	73.3
TRANSBORDER	41.8	39.4	42.7	46.2	41.9	44.2	46.7	47.1
INTERNATIONAL	5.5	5.3	5.9	6.8	7.4	7.4	7.4	7.8
TOTAL FLIGHTS	109.3	110.5	116.1	128.6	133.4	133.3	132.4	128.1

SOURCE : STATISTICS CANADA CATALOGUE Nº 51 - 203 ANNUAL.

3.3.3 User Characteristics

Trip purpose can vary considerably between the air sectors, as shown in Exhibit 11. European traffic (including scheduled and charter services) is 77% non-business, of which international charters are virtually all non-business. Passengers proceeding to or from other countries (whether on scheduled or charter flights) place much heavier demands on the airport facilities than do domestic passengers, for several reasons. They require more passenger processing facilities, such as, more baggage handling facilities, more holding space for the larger passenger loads as well as customs and immigration facilities. This means that, in total, more room is required per passenger and per aircraft to handle international travellers in the terminal area. Growth in this traffic sector imposes the greatest strain on the present passenger terminal buildings. International travel to the South is 87% non-business and places a similar demand on airport facilities. However, as noted earlier, there is greater potential for scheduling these flights outside the main peak periods.

In addition, international travel is more seasonal than domestic travel although the seasonal differences have recently become less. The tourism-oriented, low-fare, and highly seasonal traffic has a significant impact on airport operations. The coincidence of major travel peaks with school holidays tends to compound the problem.

Short distance air travel, including both domestic and transborder, tends to be highly business oriented. It shows less seasonal and daily variation than international travel. Short distance air travellers are generally familiar with airport procedures, have less or no luggage and generally impose less demand on airport terminal facilities than do international passengers. However, due to the use of smaller aircraft with lower load factors, short-haul traffic represents a significant portion of the total aircraft movements and places a proportionately greater strain on runway and other airside facilities.

3.3.4 System Conditions and Issues

Airport Roles

Within Southern Ontario, the Toronto International Airport (Malton) is not only the largest but also the region's major airport. It is the principal hub airport in Canada and

EXHIBIT II

TRIP PURPOSE OF TORONTO INTERNATIONAL AIRPORT PASSENGERS, 1976-77, BY FLIGHT SECTOR & PLACE OF RESIDENCE

FLIGHT SECTOR	TORONTO AREA RESIDENTS		NON-RESIDENTS (VISITORS)		
	% BUS.	% NON BUS.	% BUS.	% V.F.R.	% S.O.
DOMESTIC					
SHORT HAUL	80	20	75	17	8
LONG HAUL	49	51	48	44	8
TRANSBORDER					
SHORT HAUL	62	38	62	24	14
LONG HAUL	24	76	49	41	10
INTERNATIONAL					
EUROPE	23	77	19	69	12
SOUTH	13	87	22	68	10

BUS. – BUSINESS
V.F.R. – VISITING FRIENDS AND RELATIVES
S.O. – SIGHTSEEING AND OTHER

SOURCE : T.I.A. HOUSEHOLD SURVEY
T.I.A. DEPARTURE LOUNGE SURVEY

accommodates virtually all of the international, transborder and domestic long-haul air carrier traffic from and to Southern Ontario. It is the principal base for domestic short-haul air carriers, which also operate from other airports in the region, including Hamilton, London, Windsor, and Peterborough.

Toronto International Airport performs a major role as a centre for almost all types of general aviation (G.A.) activity. However, business oriented G.A. activity dominates. As a result, the airport experiences more G.A. activity during the week than on weekends (the weekend is the more common peak period at recreational general aviation airports). TIA provides facilities and services (including instrument landing facilities) that make it most attractive for the business jet component of general aviation. Other airports in the Toronto area such as Buttonville, Toronto Island, Hamilton, etc. also perform a significant role as general aviation airports but, generally speaking, for smaller aircraft.

The two major Montreal airports, Mirabel and Dorval, although not specifically within the purview of this study, have important roles to play in the national air transportation system as major entrance points to Canada. Dorval at present is the Montreal terminus for the heavily used Rapidair service between Toronto and Montreal, and handles all transborder flights to and from Montreal. Mirabel Airport is designated as the international traffic terminus for Montreal.

There are ongoing studies for the phased transfer of traffic segments from Dorval to Mirabel.

Airport Capacities

Toronto International Airport has terminal capacity to meet the present passenger demand. The runway system operates with excess capacity except for periods of adverse weather conditions. Prior to the introduction of new guidelines (March, 1979) for runway operations, which included the increase of the allowable effective crosswind component on departures from 15 knots to 20 knots, flight operations were confined to a single runway for approximately 10% of the annual operating hours, primarily due to wind conditions. This confinement to one runway reduced the effective capacity and

some delays were experienced especially during peak periods. While the effect of this increase in allowable crosswind component must be determined through monitoring, it is anticipated that this measure in conjunction with other modifications to the existing runway and taxiway system, will provide additional airside capacity.

The airport ground access system has also sufficient capacity with occasional exceptions at Terminal I.

Previous studies[1] by Transport Canada anticipated that, on the basis of present infrastructure and operating procedures, capacity shortages at Toronto International Airport will occur within the next few years. These anticipated shortages and their possible relief are being reviewed. With fiscal restraint as an objective, the search for ways and means of obtaining the maximum utilization of existing facilities is a high priority. Options of a managerial or operational nature, most of which have been identified in the Toronto International Airport Contingency Plan Study and the SOMAT Studies, could extend the utilization of specific facilities at Toronto International Airport, although these changes will alter the level of service that is currently offered.

In addressing the anticipated capacity shortage at Toronto International Airport, the role that several other existing air facilities could fulfill is presently under review. The future role of Toronto Island, Hamilton, London and the Montreal area airports may affect the role of Toronto International Airport, and eventually its ultimate life. For example, there are plans to upgrade the facilities at Hamilton airport to properly serve that area so that fewer residents of the Hamilton-Niagara-Brantford area, or Hamilton destined air passengers, would have to use Toronto International Airport.

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[1] Transport Canada, Air Transportation Administration, Toronto International Airport Contingency Plan Study, Volume II, June 1977, p. 427;

and Southern Ontario/Montreal Air Transportation Study (SOMATS), Basic Assumptions and Supply Strategies, Volume 1, p. 1.

The option of building a new international airport at Pickering is also addressed in the context of this study.

Another alternative would be to initiate restriction of general aviation activity at Toronto International Airport during peak periods. Certain types of general aviation activity are incompatible with large passenger or cargo jet aircraft if the objective is to maximize the efficiency of the operation of the airport by accommodating these larger aircraft. At TIA consideration is being given to restricting incompatible GA aircraft at peak times thereby increasing the runway capacity available for larger jet aircraft. Many problems present themselves in considering this type of restriction and no simple solutions are available. Alternative airport facilities for general aviation in the Toronto area are limited.

The environmental concerns, particularly the noise impact on the surrounding residential neighbourhoods, shapes many of the current operating procedures at Malton. Given the projected growth in aircraft movements and changes in noise reduction technology, the future noise impact must continue to receive careful consideration.

The moratorium on the number of international air carriers permitted landing rights at Toronto will be reviewed in 1980. Currently eleven additional foreign carriers are requesting admission to Toronto. The admission of more carriers could increase the demand on both the runways and the terminals. The increase in total passenger volume will depend on any new carrier's success in competing with carriers now serving Toronto, as well as on the increase in travel due to the introduction of direct service from new foreign points.

Finally, the role of other transport modes in relieving the demand on Toronto International Airport is a major issue within the context of this study. Several multimodal strategies have been considered for their potential to contribute to the resolution of the airport capacity issue. The effectiveness of the alternatives will be reviewed in Chapter 6.

It can be concluded that the air system in the Toronto area is generally adequate to handle present demand. However, it is anticipated that an increasing number of capacity constraints will arise in the near future if demand continues to grow. The impact of lower air fares and possible further regulatory changes will have to be carefully considered in this context. Therefore, the search for solutions to the air issues is a major focus in this report.

4. FUTURE TRAVEL DEMAND

4.1 Introduction

In Chapter 3, the main elements of existing inter-city transportation systems serving Southern Ontario have been described. A summary of the current usage has been provided along with a discussion of the areas where future problems may be precipitated by continuation of past travel growth trends and travel behaviour.

In order to determine the timing and form of system improvements required to accommodate future travel, it is necessary to develop estimates of the potential demand that will be placed on the respective transportation modes. This is particularly important in view of the potentially substantial investments and the long lead time required to put individual components in place.

Forecasts of travel demand are needed for two main purposes:

- to identify the critical elements within the transportation system and to assess where and when the reserve capacity of these elements will be exceeded by the rising demand, and

- to determine for how long particular capacity improvements will remain adequate, in order to calculate their cost-effectiveness for comparison with other alternatives.

In the Southern Ontario Multimodal Passenger Studies, forecasting of air travel demand has been given the main attention due to the most pressing Toronto area airports issue. Nevertheless, attempts have also been made to simulate the usage of the ground modes under various service configurations,(1) in order to determine the potential role of these modes in contributing to the resolution of the anticipated airport problem.

The following sections describe the background for these forecasts, the forecasting process as well as the results and limitations of these.

---

(1) Transport Canada, Strategic Planning Group, S.O.M.P.S., PERAM Simulation Forecasts: Toronto-Montreal, January 1979.

4.2 Socio-Economic Background

Population levels and income levels have been identified as important factors influencing the amount of intercity travel. These two factors were chosen to form the basis for development of the alternative future growth outlooks and are used to exemplify the range of possible future conditions for which travel demand forecasts have been made.

The changes in the economy and population that have taken place in the last five years have necessitated a reconsideration of previous forecasts. In the mid-seventies, Canada experienced the end of a period of rapid economic growth that had lasted, almost without interruption, from the beginning of the 1960's. At the same time, Canada's population growth rate, which in the early 1960's averaged 1.9% per year, declined through the early 1970's to an average of 1.3% per year. The ranges of possible population and economic futures used by this study in passenger forecasting are described in the following alternative socio-economic scenarios. They reflect overall national growth, but more particularly possible alternative positions of Ontario in the national perspective.

a) Scenario I

This is a high growth scenario based upon resumption of earlier rates of net migration into Ontario, from within Canada and from abroad, coupled with a growing economy sufficient to yield personal disposable incomes per capita in Ontario with a steady growth around 3% per annum (in real terms).

b) Scenario II

This scenario reflects an acceleration in the shift of emphasis of economic activity in favour of Western Canada, with correspondingly smaller gains in Ontario's population from in-migration, and a more modest growth rate in personal disposable income in Ontario of 2%.

In addition to these two alternatives an intermediate growth scenario (Scenario III) was identified to reflect recent developments and to provide an intermediate base for the sensitivity testing of particular detailed air facility proposals.

Scenario III is based on an average annual growth in real personal disposable income per capita in Ontario of 2.6%, resulting from a stabilization of structural change that is now occuring in the Canadian economy. However, the continuation of this stabilizing trend is uncertain and Scenario III represents merely one more future outlook alternative.

Exhibit 12 summarizes the growth rates for the three scenarios in successive periods to 1991. A more detailed description of the development of socio-economic factors is provided in technical background papers(1) noted in Appendix B.

4.3 The Forecasting Models

The three forecasting models used to estimate future travel were:

- the Propensity Model
- the Air Passenger Origin-Destination Model (PODM), and
- the Multimodal Passenger Model (PERAM)

In each of these models, travel volumes were forecast on the basis of assumed mathematical relationships between travel demand and predicted values of demographic and socio-economic factors.

The following sections provide brief descriptions of the nature of these models. Further documentation of the models is provided in technical background papers(2) listed in Appendix B.

---

(1) Transport Canada, Strategic Planning Group Population and Income: Estimates for 1976 and Forecasts to 1991, Selected Provinces, Census Metropolitan Areas and Census Agglomerations, October 1978.

(2) - Transport Canada, Strategic Planning Group, An Outline of PERAM Forecasts for Domestic Travel by Mode, January 1979.

- SOMATS, Forecast Summary Report, Origin-Destination Air Passenger Forecasts.

EXHIBIT 12

POPULATION AND PERSONAL REAL DISPOSABLE INCOME (PRDI) PER CAPITA IN ONTARIO; 1965 - 1977 AND THREE SCENARIOS TO 1991

PARAMETER / SCENARIO	AVERAGE ANNUAL GROWTH RATE (%)						
	ACTUAL			FORECAST			
	1965 - 70	1970 - 74	1974 - 77	1976 - 81	1981 - 86	1986 - 91	1976 - 91
POPULATION	2.1	1.6	1.2				
HIGH (SCEN. I)				1.5	1.3	1.2	1.4
INTERMEDIATE (SCEN. III)				1.4	1.4	1.2	1.3
LOW (SCENARIO II)				1.0	0.9	0.6	0.9
PRDI / CAPITA	3.2	5.9	3.1				
HIGH (SCEN. I)				3.0	3.1	3.0	3.0
INTERMEDIATE (SCEN. III)				2.7	2.6	2.5	2.6
LOW (SCENARIO II)				2.0	2.0	2.0	2.0

4.3.1 The Propensity Model

The Propensity Model is a trip generation model which forecasts air travel to and from the greater Toronto region. The model estimates travel separately for six travel sectors; domestic short and long haul, transborder short and long haul, Europe and South (Caribbean, Central and South America) based on a segmentation of population defined by total family income, birthplace (Canadian or foreign) and area of residence (Toronto Census Metropolitan Area or outlying areas).

Observed trip rates for each segment are applied to projections of future populations in each of the segments. Further modifications are made on the basis of changing travel propensity resulting from changes in fares and service within air and other modes.

The Propensity Model has been the source of official forecasts for airport planning in the Toronto region since 1974. The forecasts documented in this chapter result from an updated Propensity Model based on household and departure lounge surveys conducted in 1977.

4.3.2 The Air Passenger Origin-Destination Model (PODM)

Concurrently with the preparation of new Propensity Model forecasts for Toronto, the Canadian Air Transportation Administration of Transport Canada developed a national econometric forecasting model, the Air Passenger Origin-Destination Model (PODM), which estimates future air traffic between pairs of geographic areas or zones. Canada is divided into 60 zones, the U.S.A. into 23 zones, and the rest of the world into 9 zones. The PODM forecasts provide an opportunity to assess, in a national context, the Toronto-specific forecasts from the Propensity Model.

The factors considered in the model are: the adult population, managerial employment, personal disposable income per capita, and real air fares. The model forecasts travel separately by trip purpose (business and non-business) and by point of origin of the round trip.

4.3.3 The Multimodal Passenger Model (PERAM)

PERAM is a multimodal passenger travel demand model which was developed by the Strategic Planning Group of Transport Canada. It was adjusted to specifically meet multimodal forecasting requirements for Southern Ontario. A detailed description of the model and its results can be found in the report "An Outline of PERAM Forecasts for Domestic Travel by Mode", listed in Appendix B.

PERAM is an econometric model which forecasts travel volumes between various combinations of Canadian cities, using six variables. Three of the six are socio-economic characteristics of the cities (population, income/capita, and linguistic mix, i.e. French/English), and three describe services provided by the respective transportation modes (i.e. travel time, travel cost and frequency).

PERAM deals only with travel within Canada. In its special application to this study, the model covers approximately 45% of air traffic from and to Toronto International Airport.

In addition to providing another perspective on future domestic long and short haul air travel, this model has also been used to assess the potential role of the alternate transportation modes in specific corridors where the relative market shares may be influenced by possible changes in the service characteristics (e.g. travel speeds, frequencies and fares) of the respective modes. Section 4.5 describes the results of such simulation tests dealing with modal shift potentials on the Toronto-Montreal link.

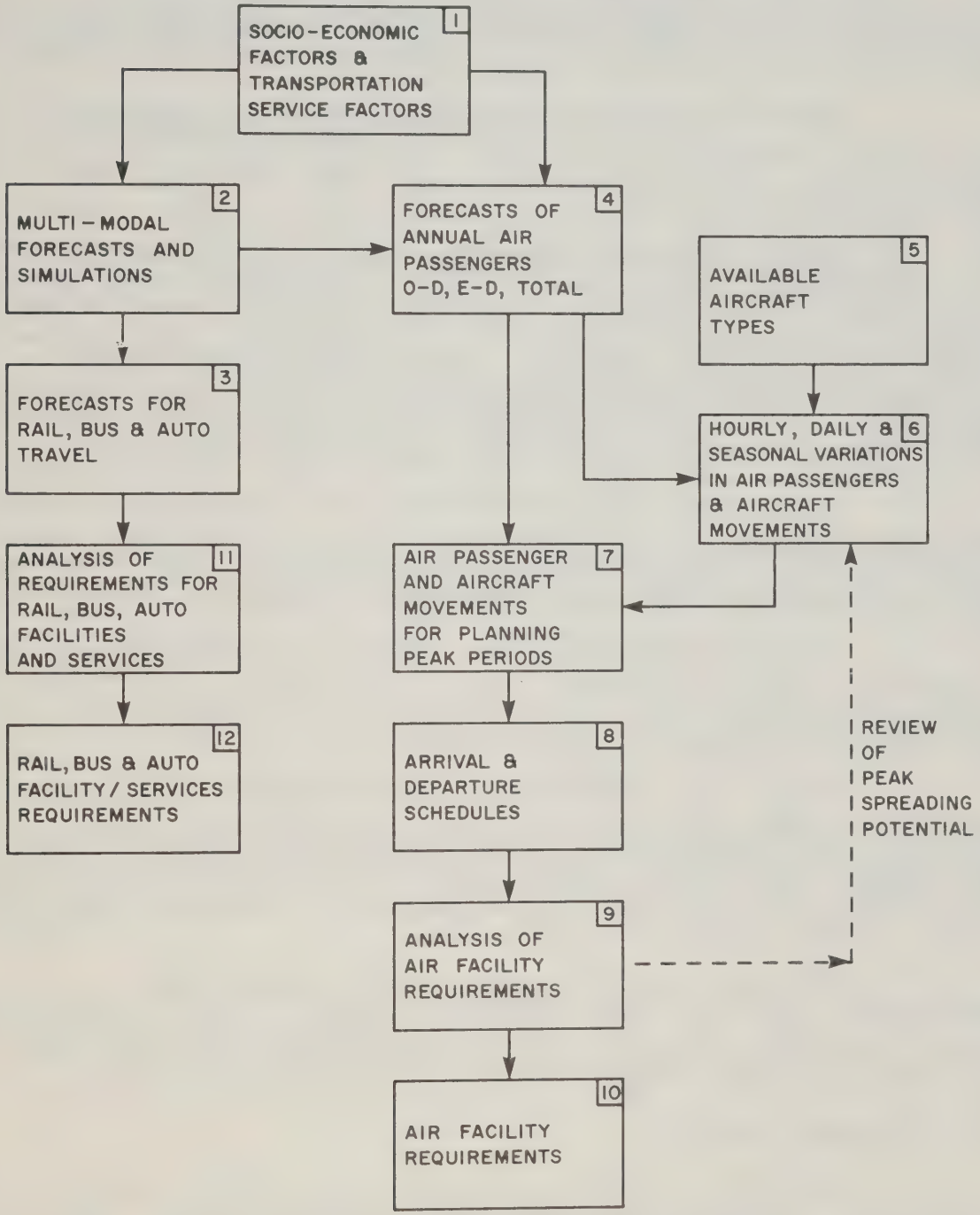
4.4 Demand Forecasting Process

Exhibit 13 gives a simplified description of the forecasting process that must be completed in order to estimate future air facility requirements as well as the potential role of the surface modes.

On the basis of estimates of future socio-economic factors and transportation service assumptions (Box 1), the forecasting models have been used to develop estimates of annual travel demand on the respective modes (Boxes 3 and 4).

EXHIBIT 13

DEMAND FORECASTING PROCESS AND ASSESSMENT OF FACILITY REQUIREMENTS



For this study, annual air passenger forecasts (Box 4) for Toronto International Airport were developed using two different air passenger forecast models (Propensity Model and PODM) with the benefit of a multimodal perspective (PERAM).

The air forecasting models produced estimates, for six flight sectors, of the number of passengers originating or having their final destination in the Toronto area (O-D passengers).

These forecasts were then modified, on the basis of current trends and assumed future conditions, to provide estimates of all passengers using the terminal facilities at Toronto International Airport (i.e. enplaning and deplaning (E-D) passengers). Finally, the estimated number of passengers arriving and departing on the same aircraft (i.e. transiting passengers) were added to produce estimates of the total number of passengers using the airport facilities.

From these annual forecasts, air passenger volumes must be detailed into planning peak movements and additionally converted into corresponding planning peak aircraft movements for the purpose of facility requirement analysis (Boxes 7-10).

This is done on the basis of assumptions with respect to future seasonal, daily and hourly variations in travel and on the basis of assumptions with respect to types of aircraft available in the future.

Total air passengers, with corresponding aircraft movements, are in general used to determine runway and terminal gate requirements. O-D passengers and enplaning/deplaning passenger estimates provide the basis for terminal requirement analysis, while O-D passenger forecasts alone are used to assess ground access needs.

In this study, updates of annual air passenger forecasts (Box 4) have been completed. The process of detailing these forecasts into planning peak estimates (Box 7) for facility requirement analysis is currently underway.

4.5 Forecast Results

As noted above, estimates of future annual air passenger volumes were developed using three different forecasting models, and based on three alternative future socio-economic scenarios.

The following sections describe the results of completed work with respect to multimodal simulations and updated annual air forecasts.

4.5.1 Multimodal Simulations

One of the objectives of the Southern Ontario Multimodal Studies was to evaluate how the surface modes, and particularly rail, could contribute in the future to the resolution of capacity problems in the air system, by attracting a proportion of travellers from the air mode.

The PERAM model was, in addition to forecasting domestic air travel in a multimodal national context, used to carry out simulations of the potential shifts in usage of the respective transportation modes, air, rail, bus and automobile, that could result from relative improvements in the service characteristics of particular modes.

These simulations were carried out for the Toronto-Montreal link,(1) since this route is served by all modes, and since the air travel between these two cities constitutes a large proportion of the short-haul traffic at Toronto International Airport.

In order to simulate the possible shifts to rail under voluntary conditions, the average operating speed and the fare of the rail mode were modified.

Average speeds and costs to the travellers were held generally constant for the other modes, while the frequencies were adjusted to reflect accommodation of the growth in travel.

Exhibit 14 shows the results of three of the simulations for 1991 and compares these with a simulation based on 1976 conditions.

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(1) Transport Canada, Strategic Planning Group, S.O.M.P.S., PERAM Simulation Forecasts: Toronto-Montreal, January 1979.

EXHIBIT 14

MULTIMODAL TEST SIMULATIONS
TORONTO – MONTREAL PERSON TRIPS
(TOTAL TRIPS & RELATIVE SHARE BY MODE)

YEAR	TOTAL TRIPS	MODAL SHARE %				KEY SIMULATION PARAMETERS		
		CAR	AIR	RAIL	BUS	RAIL FARE	RAIL SPEED (AVERAGE)	AIR FARE
1976	1,190,000	48 %	29 %	18 %	5 %	$ 23.66	70 MPH	$ 53.50
1991	2,348,000	33 %	23 %	39 %	5 %	$ 15.00	100 MPH	$ 58.15
1991	2,136,000	44 %	30 %	19 %	7 %	$ 35.00	100 MPH	$ 58.15
1991	2,124,000	48 %	29 %	18 %	5 %	$ 23.66	70 MPH	$ 53.50

NOTE : 1. DEPARTURE FREQUENCIES FOR AIR, RAIL AND BUS HAVE BEEN ADJUSTED TO ACCOMMODATE TRAVEL VOLUMES

2. FARES AND SPEEDS CHOSEN FOR SENSITIVITY TESTING ONLY AND SHOULD NOT BE CONSTRUED AS RECOMMENDED SERVICE CHARACTERISTICS

3. TEST SIMULATIONS ARE BASED ON INTERMEDIATE SOCIO - ECONOMIC GROWTH SCENARIO

4. SEE ALSO : TRANSPORT CANADA, S.O.M.P.S., PERAM SIMULATION FORECASTS : TORONTO - MONTREAL , JANUARY 1979 (APPENDIX B)

5. FARES ARE IN CONSTANT 1976 DOLLARS

4.5.2 Air Forecasts

Exhibit 15 shows the results of the new forecasts using the two air passenger models (Propensity Model and Air Passenger Origin-Destination Model) and compares these with previous annual forecasts developed in 1975.

The new estimates resulting from the two models are generally similar. However, the Propensity Model produced the wider range of passenger volumes on the basis of the high and low socio-economic growth assumptions.

For these trips, the 1975 forecasts from the Propensity Model suggested an average annual growth of 7.9% in passenger volumes during the 1976-86 period. The updated forecasts from the same model show growth rates of 7.6%, 6.5% and 5% for the high, intermediate and low growth scenarios respectively.

In Exhibit 16, the passengers who use Toronto International Airport as a connecting point have been added to the Propensity Model forecast, resulting in an estimate of the annual total volume of passengers using the airport terminal facilities (enplaning and deplaning passengers). Implicit in these forecasts is the assumption that connecting passengers in the future will constitute a smaller proportion of the total air passengers using Toronto International Airport (i.e. because of an increase in direct flights between other airports, the number of connecting passengers has been reduced from 27% to 23% of total passengers using the terminals).

In Chapter 3, the difference between historical growth in the respective air travel sectors was described. Definition of the different characteristics of these travel sectors, listed in Exhibit 17, is essential in determining future air facility requirements.

Exhibit 17 shows the existing and estimated 1986 annual air travel by sector for trips with origin or final destination in the Toronto region, and compares the high, intermediate and low forecasts with the previous estimates made in 1975.

Exhibit 18 shows similar comparisons for 1991.

For more detailed discussion of forecast results see: SOMATS Report Vol. 13 (Listed in Appendix B).

EXHIBIT 15

TORONTO INTERNATIONAL AIRPORT
ANNUAL AIR PASSENGER FORECASTS - 1986 & 1991

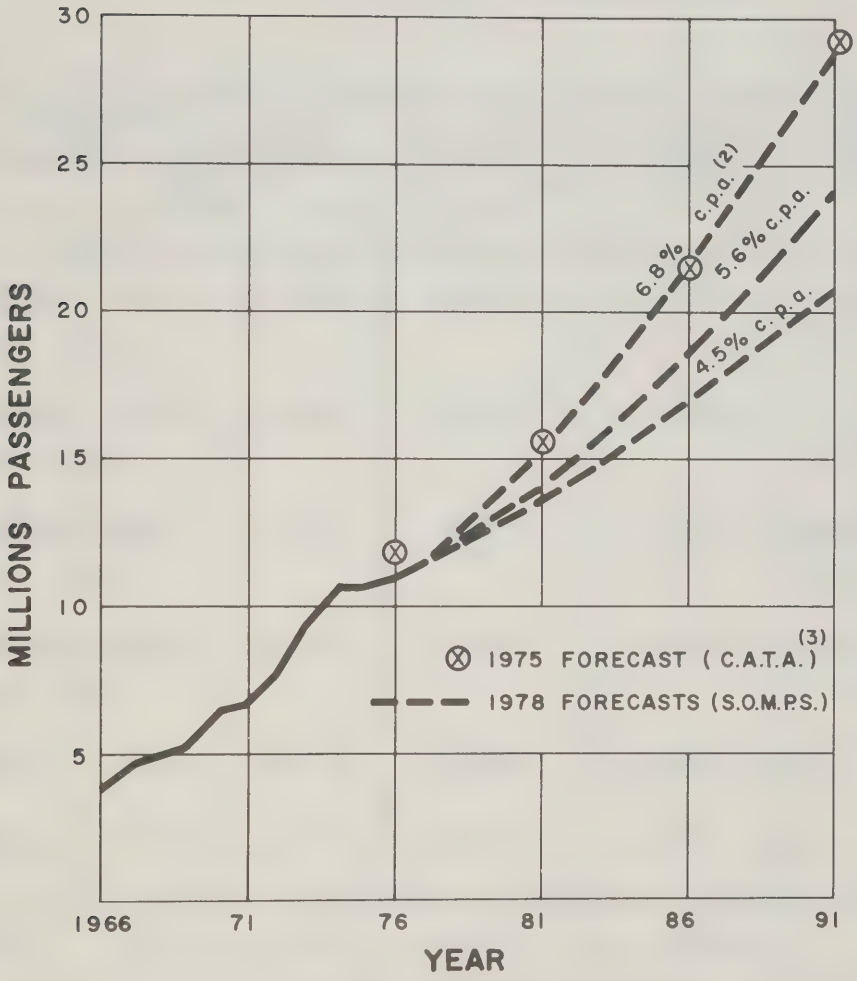
TRIPS WITH ORIGIN OR FINAL DESTINATION IN THE TORONTO REGION

FORECAST MODEL AND SCENARIO	FORECAST YEAR			
	1986		1991	
	TOTAL ('000)	CHANGE[1] FROM 1977 ('000)	TOTAL ('000)	CHANGE[1] FROM 1977 ('000)
PROPENSITY MODEL 1975 FORECAST:	17,230	8,920	23,650	15,340
PROPENSITY MODEL 1978 FORECAST:				
LOW	13,060	4,750	16,170	7,860
INTERMEDIATE	15,080	6,770	19,110	10,800
HIGH	16,790	8,480	22,830	14,520
POD MODEL:				
LOW	13,760	5,450	16,490	8,180
INTERMEDIATE	14,800	6,490		
HIGH	15,950	7,640	20,700	12,390

[1] 1977: 8,310,000 PASSENGERS

EXHIBIT 16

TORONTO INTERNATIONAL AIRPORT
ANNUAL AIR PASSENGERS[1]
ENPLANED & DEPLANED



(1) OBSERVED & FORECAST, SCHEDULED & CHARTER

(2) c.p.a.: COMPOUNDED PER ANNUM

(3) C.A.T.A.: CANADIAN AIR TRANSPORTATION ADMINISTRATION

EXHIBIT 17

TORONTO INTERNATIONAL AIRPORT
1986 ANNUAL AIR PASSENGERS FOR TRAVEL WITH ORIGIN OR FINAL DESTINATION IN THE TORONTO REGION

AIR TRAFFIC SECTOR	OBSERVED IN 1976 ('000)	FORECAST BY PROPENSITY MODEL IN 1975 ('000)	FORECAST BY PROPENSITY MODEL IN 1978 ('000)		
			LOW	INTER-MEDIATE	HIGH
DOMESTIC SHORT-HAUL	1,884	3,430	2,630	3,130	3,330
DOMESTIC LONG-HAUL	1,737	3,660	2,840	3,320	3,870
TRANSBORDER SHORT-HAUL	1,231	2,770	1,900	2,240	2,530
TRANSBORDER LONG-HAUL	1,146	2,190	2,220	2,470	2,780
EUROPE	1,379	3,380	2,110	2,410	2,610
SOUTH	676	1,800	1,360	1,510	1,670
TOTAL	8,053	17,230	13,060	15,080	16,790

EXHIBIT 18

TORONTO INTERNATIONAL AIRPORT
1991 ANNUAL AIR PASSENGERS FOR TRAVEL WITH ORIGIN OR FINAL DESTINATION IN THE TORONTO REGION

AIR TRAFFIC SECTOR	OBSERVED IN 1976 ('000)	FORECAST BY PROPENSITY MODEL IN 1975 ('000)	FORECAST BY PROPENSITY MODEL IN 1978 ('000)		
			LOW	INTER-MEDIATE	HIGH
DOMESTIC SHORT-HAUL	1,884	4,180	3,100	3,880	4,260
DOMESTIC LONG-HAUL	1,737	5,030	3,530	4,180	5,420
TRANSBORDER SHORT-HAUL	1,231	3,500	2,290	2,780	3,380
TRANSBORDER LONG-HAUL	1,146	3,100	2,930	3,280	3,960
EUROPE	1,379	5,130	2,510	2,980	3,430
SOUTH	676	2,710	1,810	2,010	2,380
TOTAL	8,053	23,650	16,170	19,110	22,830

4.6 Limitations of Forecasts

While forecasting future travel demand is essential in planning for future transportation requirements, it is recognized that there are uncertainties associated with this process.

The magnitude of future travel and the market shares of the respective transportation modes will be affected by a number of factors including:

- developments external to the transportation sector (i.e. changes in the rate, composition and location of population and economic growth, as well as availability and cost of energy),

- government and private sector ability and attitude to provision of transportation facilities and services (i.e. government funding priorities under fiscal restraint and possible further regulatory changes within the air service industry),

- developments in transportation and communications technology, and

- changes in behaviour patterns of the travelling public under varying social and economic conditions.

There are also limitations inherent in the available forecasting techniques which assume that future behaviour patterns will be affected by the same factors and to the same relative degree as today. These techniques also require that a number of judgements are made with respect to:

- changes in external factors,
- formulation and application of the techniques, and
- interpretation of the forecast results.

These uncertainties and limitations not only emphasize the need for continuous review of travel forecasts, but also stress that the manner in which forecasts are applied in the planning process is of paramount importance. As the critical decision points become closer in time, forecasts should be modified on the basis of updated knowledge. The planning and decision process must therefore be sufficiently flexible to accommodate the possibility of modified outlooks on transportation requirements.

Chapter 7 of this report describes how the forecasts may be applied in the planning and decision process while allowing for their inherent uncertainties.

4.7 Application of Forecasts

Section 4.5 described the updated estimates of future annual travel volumes and compared these to forecasts used in past planning work.

In general, the new forecasts for future annual air travel are lower than those developed in the past, although the effect of recent developments such as introduction of promotional fares, and indeed possible future regulatory changes within the aviation sector, has yet to be considered.

While these forecasts indicate in general the annual growth that may be expected, conclusions with respect to corresponding future facility requirements can not be drawn directly from the annual figures. In order to assess the timing, type and form of future transportation facility requirements, the annual forecast must be detailed into planning peak volumes and further into detailed airline schedules on the basis of assumptions regarding the possible variations in volumes of people and aircraft on a seasonal, daily and hourly basis (Exhibit 13). It is these peak volumes that must be compared with the capability of the respective transportation facility components in order to determine when and what improvements will be needed.

The factors underlying these assumptions are themselves subject to forecast uncertainties. It is therefore important to recognize that variations from the expected or the present norm in all these subsequent assumptions may have a much more far reaching effect on the future facility requirements than any variations from the expected in the annual travel volumes. The degree to which travel volumes may in the future become even further spread out over the day, week and seasons may reduce the urgency and perhaps the scale of facility requirements.

Furthermore, the extent to which any modifications in current travel peaking patterns can be effected in the future will not only depend on the actual growth in travel and the level of service which will be deemed appropriate, but will also vary with the growth within the different flight sectors due to the differences in seasonality and the constraints at other points in the air network.

As described earlier in this Chapter, a range of annual forecasts rather than one single estimate has been developed in recognition of the future uncertainties in the economic forces behind travel demand. The upper boundary of the range will, in association with lead times required to implement system improvements, indicate the likely earliest time when decisions for further course of action must be considered. Decision choices may include further deferral of action, introduction of management measures to further optimize existing facilities, or initiation of physical expansion.

It should, however, be emphasized that there is also a similar probability that travel volumes at times in the future may fall within lower segments of the range of forecasts, and it is therefore imperative that the planning and decision process retain sufficient flexibility to accommodate such possibilities. This includes the retention of the option to defer commitments to build if the evidence indicates a slower growth in travel demand.

The forecasts presented above should therefore be viewed in conjunction with the planning and decision process suggested in Chapter 7 of this report.

5. TRANSPORTATION SUPPLY ALTERNATIVES

5.1 Introduction

The existing conditions and issues within the intercity passenger transportation system in Southern Ontario were outlined in Chapter 3. It was indicated that requirements for additional system capacity are more urgent for the air mode than for other modes of intercity travel. Previous studies[1] indicated that travel volume would exceed the capacity of the Toronto International Airport at Malton in the late 1970's. Subsequent work[2] indicated that there will be capacity problems in the early 1980's in the two existing terminal buildings, and later, perhaps in the late 1980's, the capacity of the existing runway system will be exceeded.

This chapter will describe the various measures, and combinations thereof, which were considered to alleviate the anticipated capacity shortfall at Toronto International Airport. They include both physical and operational improvements to the air passenger transportation system, as well as modifications to the surface modes where the contribution of these modes to the resolution of the airport issue should be considered.

The initial compilation of relief measures, as listed in section 5.2, was developed on the basis that future passenger demand would be accommodated although not necessarily at the current level of service or according to the traditional market shares of the respective transportation modes.

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1 Report of the Airport Inquiry Commission (Gibson Commission), 1974.

2 Transport Canada, Air Transportation Administration, Southern Ontario/Montreal Air Transportation Study (S.O.M.A.T.S.) (See Appendix B, II).

Measures aimed at reducing the total demand for intercity travel, such as increased use of telecommunications, were not specifically considered. Related studies[1] suggest some potential for substitution of certain types of intercity business travel by telecommunications, for example through increased use of teleconferencing. However, substitution of business travel by telecommunications is not expected to significantly affect transportation decisions in the short term.

The initial list of supply options also excludes technology which is not likely to be available within the next decade, such as advanced guided ground transportation systems.

5.2 Elements of Alternatives to Deal with Anticipated Capacity Shortfall at Toronto International Airport

The following sections include a number of elements, both physical and operational, which have been identified by other studies,[2] as well as some which have been suggested by other agencies and the public during the course of this study. It also includes some elements which have since been rejected.

The majority of these elements have been previously listed and discussed in the Toronto International Airport Contingency Plan Study conducted by the Canadian Air Transportation Administration. As a result, some of the elements are currently being implemented and others must still be subject to evaluation as to their feasibility and effectiveness. The list should therefore not be construed as an account of recommended measures, but is intended as a base for further evaluation and for continuous monitoring as to the effect of implemented measures.

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(1) Transport Canada, Strategic Planning Group, The Potential for Telecommunications as a Travel Substitute, Role of the Automobile Study, Working Paper No. 10, January 1979.

(2) Transport Canada, Air Transportation Administration, Toronto International Airport Contingency Plan Study, and Southern Ontario/Montreal Air Transportation Study, (SOMATS).

It should also be noted that no individual measure will alone provide an answer to future capacity requirements. Because of the complex nature of an airport the appropriate combination of elements must be defined, and physical and operational modifications are likely to proceed in parallel.

Possible measures to deal with the anticipated future lack of capacity at Toronto International Airport can be classified into two major groups:

i) actions to increase the capacity of Toronto International Airport, and

ii) actions to reduce the demand pressures on Toronto International Airport by diverting traffic to other modes or airports.

The courses of action within each of these groups may be sub-divided as follows:

a) management or operational alternatives which involve changes in the way that transportation facilities are used, and

b) infrastructural or physical alternatives, i.e. additions to the existing transportation facilities.

5.2.1 Actions to Increase the Capacity of Toronto International Airport

a) Management or Operational Options

Operating Methods and Practices

(Note: Most changes in operating methods and practices will involve also some investments in facilities.)

1. Process passengers at a location other than the airport, e.g. hotel lobbies or a terminal building not on airport property.

2. Change the existing roles of terminal buildings 1 and 2 and regroup airline services accordingly.

3. Change operational and traffic management procedures related to air traffic control and airside operations, e.g. increase the allowable crosswind component to 20 knots for departures(1), introduce profile descents, time slot scheduling, and simultaneous independent operations of existing parallel runways.

4. Change passenger inspection service procedures including preclearance at other airports.

5. Change practice to enable extended hours of airport operation and maximum use of most efficient runways during peak periods.

Regulations and Pricing

1. Restrain segments of, or all, general aviation during peak periods by various measures, such as pricing or scheduling.

2. Spread daily and weekly peaks by pricing and/or scheduling regulations to encourage airlines to operate at times other than on peak days and during peak hours.

3. Reduce number of greeters/wellwishers through, for example, introduction of airport access pricing measures such as increased short-term parking fees.

b) Physical Options

Improvement of Existing Facilities at Toronto International Airport

1. Reconfigure terminal building 1 and/or 2 (a complementary physical measure to changes in role assignments or as a consequence of the development of a third terminal).

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(1) Implemented March 1979.

2. Modify airside components (runways, taxiways, aprons) and introduce use of passenger transfer vehicles (PTVs).

New Facilities at Toronto International Airport

1. Construct an interim terminal building on the east side.

2. Construct a permanent terminal building on the east side (possibly staged construction).

3. Construct an offsite terminal building.

4. Construct a permanent terminal building on the west side.

5. Construct a fourth runway on the west side (Technical Feasibility Study of a fourth runway was terminated in November 1978).

5.2.2 Actions Aimed at Reducing Traffic Growth at Toronto International Airport

All actions to reduce traffic growth at Toronto International Airport will require the use of some managerial measures (regulatory, procedural or pricing) either with or without expansion of existing alternative facilities or construction of new facilities.

a) Managerial and Regulatory Options

1. Intensify marketing of VIA Rail service.

2. Intensify marketing for intercity bus services.

3. Encourage charter travel diversion to Mirabel.

4. Optimize the use of existing capacity at alternative airports in Southern Ontario, through diversions (general aviation, charter and scheduled flights).

5. Reduce demand pressure at Toronto International Airport by encouraging more direct flights (i.e. reduce need for connections in Toronto).

6. Continue to limit access by foreign airlines.

b) Physical Options

1. Continue to develop Hamilton Civic Airport to serve natural local demand and some Toronto area charter travel.

2. Develop London airport to handle some Toronto area charter travel and to serve as a hub for travel to and from Western Canada.

3. Construct a new general aviation airport for the Toronto area.

4. Improve facilities at Toronto Island Airport to handle more general aviation and limited STOL traffic.

5. Construct STOLports near major urban centers such as: Montreal, Ottawa and Toronto (e.g. Toronto Island Airport).

6. Introduce STOL shuttle service between a STOLport in Toronto and Mirabel to serve diverted charter passengers.

7. Develop the Pickering site as special purpose airport to handle charter aircraft, business jets and other general aviation.

8. Construct a new Toronto International Airport at the Pickering site.

9. Accelerate VIA Rail improvement program in the Quebec City-Windsor Corridor.

10. Develop a high-speed rail system between Toronto-Ottawa-Montreal.

11. Improve flow of intercity bus services through built-up areas, e.g. reserved lanes and traffic light priorities.

12. Develop high-speed, luxury bus system between Toronto-Ottawa-Montreal.

5.3 Supply Strategies and Application for Decision Making

5.3.1 Preliminary Supply Strategies

The above elements were initially combined into distinct groups describing possible alternative courses of action or strategies to respond to the expected capacity problem at Toronto International Airport.

Each strategy has more than one variant, reflecting important alternative development options or alternative phasing of options over time within the same broad philosophy. The formulation of the supply strategies starts from a basis consisting of the 1976 Southern Ontario passenger transport system including all new projects firmly committed and involves optimization of the use of existing facilities at Toronto International Airport. The strategies and variations are described in broad terms below. A more detailed description can be found in Southern Ontario/Montreal Air Transportation Study Volume 1, Basic Assumptions and Supply Strategies.

STRATEGY 1a. MINIMUM DEVELOPMENT AT TORONTO INTERNATIONAL AIRPORT (WITH DIVERSION OF TRANS-ATLANTIC AIR CHARTER TRAFFIC TO MIRABEL AIRPORT)

This strategy is highlighted by virtually no change to facilities at Toronto International Airport. The main elements to handle the forecast travel are:

a) changes to procedures at Toronto International Airport (e.g. terminal operation, crosswind limits, peak spreading, etc.) which would provide some increase to Malton's capacity,

b) development of high speed rail (up to 250 km/h or 150 mph) and high speed bus (150 km/h or 95 mph), to relieve Toronto International Airport by accommodating short distance travel (up to 800 km or 500 miles in length), and

c) diversion of overseas charter travel from Toronto International Airport to Mirabel Airport with high speed rail or STOL shuttle service to Toronto.

STRATEGY 1b. MINIMUM DEVELOPMENT AT TORONTO INTERNATIONAL AIRPORT (WITH NO DIVERSIONS TO MIRABEL AIRPORT)

This strategy is similar to strategy 1a except that some charter air travel is diverted to London, Ontario with no diversions to Mirabel Airport.

STRATEGY 2a. MODERATE DEVELOPMENT AT TORONTO INTERNATIONAL AIRPORT (WITH DIVERSION OF TRANSATLANTIC AIR CHARTER TRAFFIC TO MIRABEL AIRPORT)

This strategy is similar to strategy 1a in optimizing facilities at Toronto International Airport and diverting transatlantic charter traffic to Mirabel. It differs in that it proposes STOL for short haul travel, is less reliant on high speed rail, excludes high speed bus, and assumes additional runway and additional east side terminal facilities at Toronto International Airport. London would handle some charter traffic diverted from Toronto as well as serve as a hub for Western Canada travel. Toronto Island Airport would handle STOL traffic.

STRATEGY 2b. MODERATE DEVELOPMENT AT TORONTO INTERNATIONAL AIRPORT (WITH NO DIVERSIONS TO MIRABEL AIRPORT)

This strategy is similar to 2a except it relies less on diversion of traffic from Toronto International Airport and excludes diversion to Mirabel Airport. Some diversion is considered to London, STOL, and high speed rail.

STRATEGY 3. MAJOR NEW FACILITIES AT TORONTO INTERNATIONAL AIRPORT

This strategy is similar to strategy 2b except that it attempts to make maximum use of the existing site at Toronto International Airport. A fourth runway and a west side terminal building are included. Because of the capacity increase this strategy might provide at Toronto International Airport, no major diversion to other airports or other modes is considered.

STRATEGY 4. NEW TORONTO INTERNATIONAL AIRPORT AT PICKERING

'This strategy proposes to meet anticipated increased air travel volume by building a new airport at Pickering to handle mainly international travel. The present Toronto International Airport will remain the major facility for North American air traffic. Diversions to other airports or modes are considered only as interim measures to divert air traffic.

5.3.2 Application for Decision Making

These supply strategies are not intended as alternatives for governmental decision making but are developed to present contrasts within which each selected supply element can be analyzed in relation to other supply elements in order to define their potential contribution.

The above supply strategies and individual components were subject to evaluation in the Southern Ontario/Montreal Air Transportation Study(1) and other work(2) carried out for the Southern Ontario Multimodal Passenger Studies.

Although this evaluation mainly was carried out using the 1975 forecasts of future air travel, the work has provided a basis for establishing a perspective on early decision requirements. It also provided a basis for initial screening and elimination of some of the individual supply elements.

The following list summarizes the main exclusions based on this evaluation:

a) High speed rail service (150 mph or 250 km/h average speeds) has been eliminated as a short term option for short haul travel and as a shuttle service between Mirabel Airport and Toronto for trans-atlantic air charter passengers.

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(1) See Appendix B, Southern Ontario/Montreal Air Transportation Study (SOMATS).

(2) See Appendix B, III. Rail and IV. Highway.

b) STOL shuttle service between Mirabel Airport and Toronto for transatlantic air charter passengers was also eliminated.

c) High speed bus service on exclusive lanes for short haul travel was eliminated as a short/medium term alternative.

The reasons for the exclusion of these elements are provided in Chapter 6, Preliminary Findings and in technical background papers.

In addition, technical feasibility studies of a fourth runway at Toronto International Airport have been terminated (Ministerial statement, Hansard, November 28, 1978).

From previous work and the preliminary evaluation of the supply strategies, it has been determined that due to the lead time required for implementation of some of the major elements, there is a limited number of options available to respond to expected capacity problems at Toronto International Airport in the short and even medium term.

The following list provides a summary of some of the major elements which may be possible alternatives in the respective time frames. For the physical improvements, the list represents the earliest likely time that full development of these elements can be made available if implementation is deemed desirable on the basis of a full evaluation.

Short Term (Approximately 1979-1983)

a) Traffic Management Measures, including

- peak spreading
- general aviation constraints at Toronto International Airport
- runway use improvements
- preprocessing at Mirabel Airport

b) East side third terminal building at Toronto International Airport (capable of future expansion).

c) STOL services.

d) Continued VIA Rail improvements.

e) Continued bus service improvements.

Medium Term (Approximately 1984-1987)

a) Diversion of air traffic to Hamilton and London airports.

b) Expansion of third terminal at Toronto International Airport.

c) Special purpose airport facility at the Pickering site for e.g. general aviation traffic.

d) Additional passenger rail improvements.

Long Term (after 1988)

a) Major expansion at Toronto International Airport (i.e. west side development).

b) New international airport at the Pickering site.

c) Major high speed passenger rail improvements.

Due to the uncertainties associated with forecasting the future travel demand, and indeed the uncertainties as to the feasibility, availability and success of the individual supply elements discussed in this chapter, it was concluded that no single distinct package of supply features could be established for the long term response to the anticipated capacity problem at Toronto International Airport.

The Southern Ontario Multimodal Passenger Studies have therefore developed a planning and decision process which will form the framework for the evaluation, selection and implementation of supply elements as required over time. This process is described in Chapter 7.

6. PRELIMINARY FINDINGS

6.1 Introduction

The study has identified a number of areas where uncertain rates of changes are likely to occur in the future. These changes may have significant implications on the requirements for future supply of intercity passenger transportation services. They include:

- changes in the rate, composition and location of economic growth;
- changes in the social and demographic structure within Canada;
- changes in behaviour patterns relative to changing economic, social, demographic and environmental conditions;
- changes in energy availability and cost;
- changes in transportation and communications technology; and,
- changes in government regulation, operating costs and fares charged to the travelling public, with resultant changes in the travel patterns.

It is in the context of this potentially volatile environment that the Southern Ontario Multimodal Passenger Studies have attempted to review both the short and long term intercity passenger transportation requirements, with particular emphasis on conditions at Toronto International Airport.

> *The future uncertainties indicate that there are significant limitations implicit in long range forecasts of travel demand, as well as in the assessment of the capabilities of the existing transportation system and future modifications to this system.*

6.2 General Findings

Planning and Decision Process

The previously described volatile environment and the resulting broad range of possible travel demand, place distinct and realistic limitations on the capabilities of traditional long range investment planning. For example, the forecast growth in air travel from 1976 to 1986 has a spread of approximately 50% as a result of the differing socio-economic assumptions. As may be expected this difference tends to increase the further the forecasts are projected into the future.

These uncertainties make it difficult to specify the critical timing of decisions regarding provision of additional capacity in the system, particularly in the medium to long term.

The high forecast will act as an early warning for when decisions to commence planning should be considered. The decisions to implement may be delayed until the best estimates indicate that the necessary implementation lead time has been reached.

It is desirable to adopt a planning and decision process in which decisions may be deferred as long as prudently possible and made in due time with the benefit of the most current information. The background and application of the Decision Point Process are discussed in Chapter 7.

In view of the uncertainties facing the transportation sector, definite long range commitments for transportation investments should not be made at this time. However, uncertainties always exist; therefore, at some stage long-range investment decisions will have to be made. To accommodate these considerations a decision process is being pursued to allow for:

a) deferral of decisions as long as prudently possible, and incremental improvement decisions to be made on the basis of an assessment of both short and long term implications at each decision point;

b) the adaptation to conditions as they prevail and uncertainties as they clarify over time, on the basis of continuous multimodal planning.

Forecasts

A basic step in planning is the estimation of the likely future travel demand. The study has identified and selected future socio-economic scenarios which incorporate a range of assumptions about developments in the economy and population. Based on these assumptions, as outlined in Chapter 4, various models were used to produce a range of travel demand forecasts (see Exhibits 15, 16 and 17).

A new range of annual air travel forecasts for Toronto International Airport has been established for the ongoing planning process. For facility analysis purposes, these forecasts are subject to further detailing such as development of planning peak hour forecasts for passenger and aircraft movements.

It will also be necessary to review both the assumptions and judgements implicit in the forecasting process and the actual forecasts in the future, to maintain their validity over time.

Particular emphasis must be given to the effect of promotional air fares and possible deregulation of air services when reviewing demand forecasts. The introduction of the promotional fares for travel within Canada is too recent to assess the possible longer term effects at this point in time.

A specific range of annual air travel demand based on various socio-economic assumptions has been adopted for planning purposes at this point in time. However, the effect of promotional air fares and possible regulatory changes has not yet been considered.

Capacity Concerns

With planned and committed highway improvements, which in most cases will be triggered by relatively short distance commuting as well as week-end recreational travel, the major highways to and from the Toronto region generally will have adequate capacity to handle the normal trend of growth.

Previous assessments have indicated that the passenger rail system has adequate capacity to handle normal trend of growth.

However, it is expected that there will be capacity shortfalls at Toronto International Airport if travel growth occurs at the anticipated rate.

While continuous analysis is necessary to establish the critical timing of decisions and implementation of additional system capacity, requirements for responding to capacity concerns within the air mode are more urgent than for other intercity modes.

6.3 Surface Modes

The existing conditions and issues within the ground modes were outlined in Chapter 3.

Highways

Most major cities in Southern Ontario are connected by four lane highways. These operate currently with sufficient capacity and, with committed and planned improvements, are expected to do so for the foreseeable future.

On routes between the centres which are the main generators of short haul air traffic, improvements (and consequently additional investments) will be required mainly in and around the urban areas to accommodate the peaking of both commuting and weekend recreational travel which continue to put pressure on the existing highway infrastructure.

On the same routes, beyond the vicinity of the urban areas, the highway system could accommodate additional traffic which may be diverted onto it, as a result of possible facility constraints in other modes.

With committed and planned improvements, the intercity road network is expected to have sufficient capacity in the foreseeable future between the centres which generate the majority of the short haul air traffic at Toronto International Airport. Improvements will mainly be required in and around the urban areas to accommodate both commuting and weekend recreational travel.

Intercity Bus Services

With respect to the intercity bus industry, it has been concluded that the operators have the capability to adjust the capacity of their individual route services as demand varies by hour, week or season due to the relatively small size and versatility of the equipment.

The intercity bus industry is likely to retain the capability to respond to variations and growth in demand by route.

Passenger Rail Services

As previously identified (Chapter 3), intercity passenger rail service has recently experienced a turnaround in ridership. After years of declining ridership, the last few years have seen passenger increases, although with substantially increased financial losses. With trains in Southern Ontario averaging less than a 50% load factor, the existing passenger system has capacity to accommodate substantial growth, except for particular peak times of the year, without system changes in terms of frequency or train size. VIA Rail is currently investigating ways and means of bringing the existing supply into better alignment with the demand, thereby reducing costs and increasing load factors. It should also be noted that there is currently sufficient rail equipment in Southern Ontario to accommodate natural growth as well as shifts from other modes. However, some of the rolling stock is outdated and will require refurbishing or replacement in the future.

Except for particular peak times of the year, passenger rail services currently operate with substantial spare capacity on the main routes in Southern Ontario.

6.4 Passenger Rail and the Toronto International Airport Issue

Within this study, emphasis on the ground modes and rail in particular has been to ascertain their capability to contribute to the resolution of the air mode issue at Toronto International Airport.

Passenger Rail and Long Haul Travel

Due to its superior travel time, the air mode has a distinct advantage on continental long distance trips both for the businessman and the recreational traveller. Air has a virtual monopoly in overseas travel.

The analysis of the current distribution of air passenger demand by flight sector (Chapter 3) and the projected growth in air travel in each sector (Chapter 4) show that the international and long haul markets comprise the major portion of all air travel. It is also these sectors which in the past have been, and in the future are expected to be, the fastest growing segments of the air market. The international and long haul sectors are expected to be the main source of difficulty in accommodating demand in the air mode due to their expected growth, their constraints on arrival and departure times, and due to their greater passenger handling requirements in the terminals. As previously mentioned, passenger rail services are not an alternative for this air market.

> *Long haul and international markets are beyond the competitive reach of passenger rail services and will alone over time trigger additional air facility investments.*

Passenger Rail and Short Haul Travel

In the domestic short haul air market, two routes, Toronto-Montreal and Toronto-Ottawa, account for the major volume. These routes presently carry approximately 13% of the total air passengers using the terminal facilities at Toronto International Airport. All other domestic short haul markets combined account for approximately 3% of enplaning and deplaning air passengers at Toronto International Airport.

Multimodal simulations were carried out in this study to analyze the capability of rail services to relieve the air mode, based on a voluntary choice of modes. The simulations for the Toronto-Montreal route (Exhibit 14) indicated that, while substantially increased rail travel could be expected as a result of significant reductions in rail travel times and fare levels, it would not appreciably reduce the growth of air passengers, and therefore not contribute measurably to deferral of additional capacity requirements at Toronto International Airport.

The opportunity for passenger rail services to provide relief to Toronto International Airport is limited to the domestic short haul travel sector, and even in this sector measurable relief, is primarily limited to the Toronto to Montreal and Ottawa markets, which account for about 13% of the total air passengers using the terminals at Toronto International Airport. However, the analysis has indicated that there is limited potential for voluntary shift from air to rail on the Toronto-Montreal route, even with substantially increased rail speeds and lower fares.

High Speed Rail

A preliminary evaluation of very high speed (200-250 km/h or 125-150 mph, average) rail to service the Toronto-Ottawa-Montreal corridor has been completed to assess the potential for such a service for all short haul air passengers as well as some international charter passengers diverted from Toronto International Airport to Mirabel Airport.

Exhibit 19 summarizes the preliminary findings for various levels of high speed rail in terms of construction costs and years to complete. While moderate improvements may gradually be implemented, full development of high speed rail services will not be available as an alternative to defer anticipated capacity requirements at Toronto International Airport in the near future.

With an estimated lead time for full implementation of up to 12 years at a cost of approximately $0.75 - 1.1 billion, high speed passenger rail services (200-250 km/h or 125-150 mph average speed) will not be available to provide sufficient and timely relief to Toronto International Airport for short to medium term capacity requirements.

EXHIBIT 19

PRELIMINARY ASSESSMENT OF HIGH SPEED RAIL SERVICE OPTIONS FOR TORONTO - OTTAWA - MIRABEL (MONTREAL)

AVERAGE SPEED	TRACK REQUIRE-MENTS	ESTIMATED LEAD TIME (YEARS UNTIL COMPLETION)	MINIMUM TRAVEL TIME (HOURS)	LINE CONSTRUCTION COST ESTIMATES[1] IN MILLIONS	
				CROSSING EVERY 5 MILE	CROSSING EVERY 1 MILE
95 MPH (175 km/h)	SINGLE	5	3.5	$ 270	$ 500
95 MPH (175 km/h)	DOUBLE	10	3.5	$ 575	$ 800
125 MPH (230 km/h)	DOUBLE	12	2.7	$ 735	$ 980
150 MPH (280 km/h)	DOUBLE	12 - 15	2.25	$ 830	$ 1085

(1) INCLUDES COST FOR SIGNALS, TELECOMMUNICATION AND A 40 % CONTINGENCY FOR PLANNING AND OVERHEAD. POSSIBLE TERMINAL AND LAND COSTS ARE NOT INCLUDED. COSTS IN CONSTANT 1978 DOLLARS.

SOURCE : S.O.M.P.S. CAPITAL COST ESTIMATION FOR HIGH SPEED RAIL LINES, MAY 1978 , APPENDIX B .

Future Rail Improvements

Although very high speed rail passenger services will not be available to relieve the air mode in the short to medium term, studies are being undertaken to explore gradual and moderate service improvements. VIA Rail Canada is formulating a series of proposals to upgrade rail passenger service in Canada. The proposals include both new equipment and track improvements. These gradual improvements may, in combination with other measures within the air mode, over time contribute to the deferral of later investments in air facilities. The ability of the rail mode to attract air passengers will not only depend on operating speeds and quality of equipment, but also on fare policies adopted to recover improvement costs and a greater portion of operating costs.

The extent to which the rail passenger mode might affect in the long term the requirements for investments in air facilities must continue to be evaluated as this mode is developed.

Planning Flexibility

In view of future uncertainties with respect to energy availability, growth in travel demand and effectiveness of improvement measures within the air mode, planning and implementation of public surface mode improvements should be conducted so as not to exclude a range of higher future service objectives. These may include such high speed operations as may be required for these surface modes on their own merits and/or to provide modest relief to the air mode.

6.5 Air Mode

Air Traffic Forecasts:

The new air passenger forecasts are, on an annual basis, lower than the forecasts prepared in 1975 (See Chapter 4, Exhibit 15). These new forecasts also indicate some shifts in travel by sector. For example, on an annual basis, the European market share is lower than in previous forecasts and the long haul transborder (mainly to U.S. sunspots) has increased from previous forecasts.

As indicated in section 6.2, further analysis is required to detail the annual forecasts into terms which can be used for facility analysis.

The new forecasts have not yet taken into account the effects of recent developments in incentive fares, domestic charter services and deregulation. These aspects need to be monitored to determine their impact on future travel demand.

New forecasts indicate that air passenger volumes, on an annual basis, in total will be lower than previously estimated. However, further detailing of the new annual forecasts particularly for the planning peak period conditions, is needed in order to determine corresponding facility requirements. There is also a need to monitor the effects of incentive fares, new domestic charter services and possible regulatory changes.

Surface Modes and Air Issue

Sections 6.3 and 6.4 have indicated that drastic improvements in the surface modes would require long lead times for planning and construction with limited impact on reduction in air travel. However, capacity shortages are anticipated in the short to medium term for various elements of the air system at Toronto International Airport if the expected growth in travel does occur.

The response to anticipated capacity shortages at Toronto International Airport must initially be addressed within the air sector.

Capacity Considerations for Toronto International Airport

Numerous measures within the air sector that could possibly form part of the response to the anticipated capacity shortages at Toronto International Airport have been listed in Chapter 5. These can be broadly classified as diversion, as procedural and demand management measures, and as measures to physically expand the capacity of Toronto International Airport (i.e. provide new facilities) and to provide additional capacity at a new site.

Previous studies, including the Toronto International Airport Contingency Plan Study, have made recommendations to study and implement managerial measures aimed at optimizing the use of existing facilities. Several recommendations which will increase operational efficiency have already been implemented, such as increasing the allowable crosswind component on departures and improvements to the runway/taxiway system. These measures plus others will to the extent that they can be successfully introduced, increase the available capacity of the runway system at Toronto International Airport.

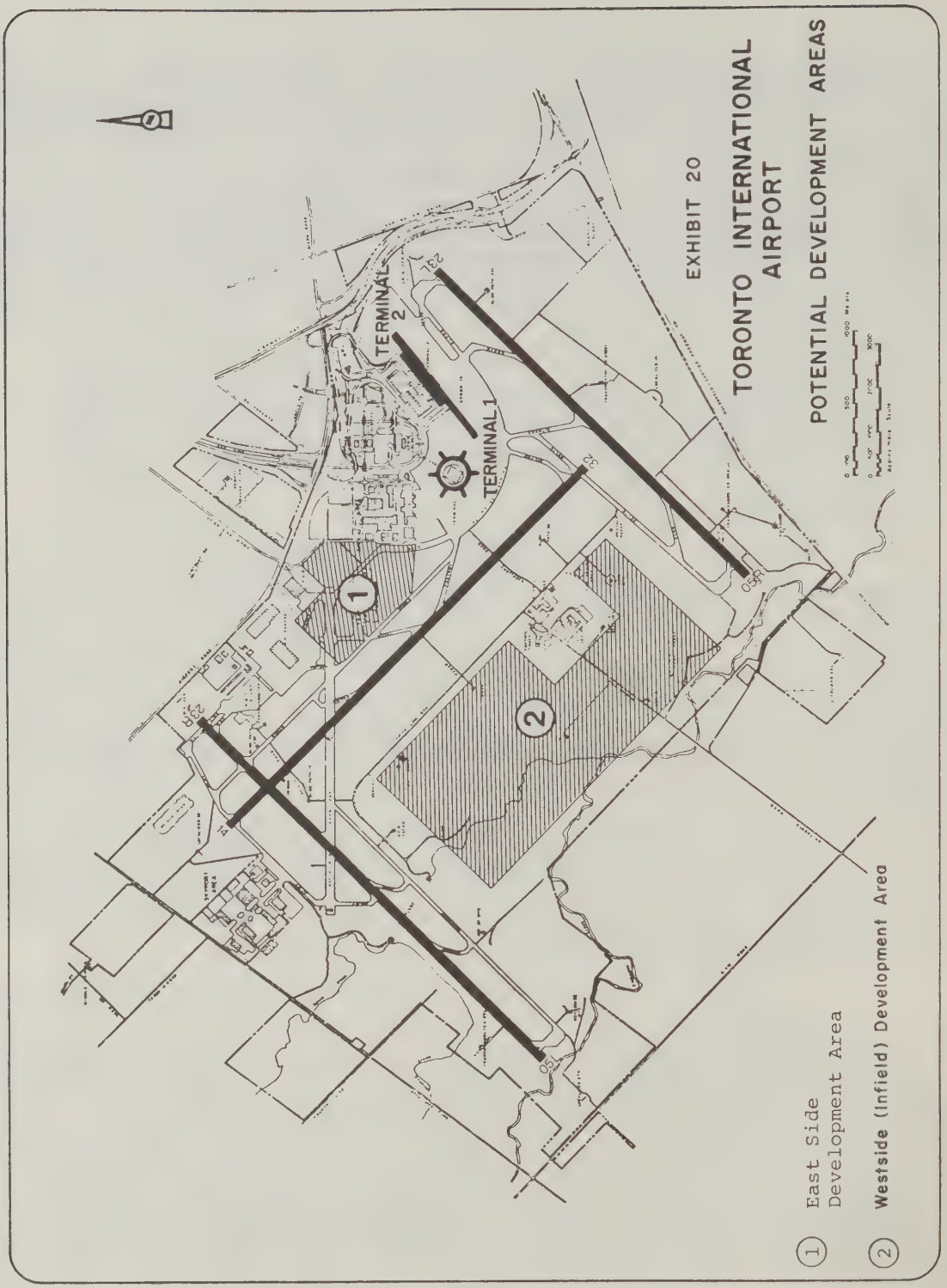
On the basis of previous forecasts, it has now been estimated that the existing runway system at Toronto International Airport will be adequate for at least the next decade, provided additional traffic management measures are successful.

Therefore, the first major capacity deficiencies are anticipated to occur within the terminal buildings. To delay this occurrence, such measures as peak spreading, relocating air carriers between terminals and modifications to other operating procedures are being examined. However, even with these measures, it appears that there will be a significant shortage of terminal capacity and an imbalance will exist between the available runway capacity and terminal capacity at Toronto International Airport.

In an attempt to resolve this shortage in the terminal system, several concepts and potential development areas (Exhibit 20) for providing additional terminal capacity were reviewed. Exhibit 21 summarizes the concepts in terms of size, availability, and cost.

A technical feasibility study has recently concluded that it is technically and operationally feasible to construct a new terminal building between the cargo and aircraft maintenance areas on the east side of the airport property. However, further studies are continuing to define the role, timing and necessary size of a potential third terminal.

The present Toronto International Airport site will likely be adequate for at least the next decade, contingent upon:


TERMINAL 2
TERMINAL 1
1
2
EXHIBIT 20
TORONTO INTERNATIONAL AIRPORT
POTENTIAL DEVELOPMENT AREAS
1 East Side Development Area
2 Westside (Infield) Development Area

a) Successful implementation of appropriate recommendations of the Toronto International Airport Contingency Plan Study,

b) Continuous vigorous pursuit of operational efficiencies and demand management steps, and

c) Achievement of additional terminal capacity.

First Major Decision Point

As indicated in Exhibit 21 additional terminal capacity depending on size, location and function could take up to 6 years to fully achieve. A terminal building capable of future expansion on the east side could, however, be available within 3-4 years. If anticipated capacity shortages do not occur until the early to mid 1980's, a decision with respect to additional terminal capacity can be deferred for another 6-12 months. This deferral is also predicated on the need to complete detailing of new demand forecasts and to continue evaluation of all supply options in terms of the new forecasts prior to any major decision with respect to providing additional capacity for air travel. This further work is discussed in Chapter 8. However, it is necessary to continue now with detailed planning studies for a possible third terminal building, so that if a decision is made to construct such a facility it can be made operational with a minimum of delay. Such studies should include considerations for future air cargo handling requirements.

The first major decision with respect to additional air system capacity, including a possible third terminal at Toronto International Airport, can be deferred 6-12 months. However, due to the lead time required for implementation, conceptual planning and definition of operational requirements for a third terminal should be undertaken now, in the event that an investment decision will be required in the short term.

Diversions to Other Airports and STOL

Measures which attempt to divert Toronto International Airport passengers to other air facilities were briefly considered within the study.

EXHIBIT 21

OPTIONS FOR ADDITIONAL TERMINAL FACILITIES AT TORONTO INTERNATIONAL AIRPORT

LOCATION	SIZE (SQ. FT.)	AVAILABILITY (YRS. TO OPENING)	COST (CAPITAL ESTIMATE)[4] (MILLIONS OF 1977 DOLLARS)
EAST SIDE INTERIM TERMINAL	270,000	3	$ 80 [1]
EAST SIDE MODERATE TERMINAL	option A 300,000	5	$ 130 [2]
	option B 660,000	5	$ 200 [2]
WEST SIDE MAJOR TERMINAL	850,000	6	$ 750 [3]

(1) INCLUDES : FACILITIES (TERMINAL, UTILITIES, APRONS, GROUND ACCESS) EQUIPMENT, PLANNING, OVERHEAD AND THIRD PARTY COSTS.

(2) INCLUDES : TERMINAL, APRONS, ON-SITE ACCESS, UTILITIES, PLANNING AND OVERHEAD COSTS.

(3) INCLUDES : FACILITIES (TERMINAL; RUNWAY; APRONS; TAXIWAYS; ONSITE ACCESS AND SUPPORTING FACILITIES), UTILITIES, EQUIPMENT, PLANNING AND OVERHEAD , THIRD PARTY AND OFF-SITE INFRASTRUCTURE COSTS.

(4) ALL COSTS REPRESENT ORDERS OF MAGNITUDE ONLY

Various roles for a STOL system were reviewed. These roles include:

- shuttle service with STOL aircraft to and from Montreal for international charter passengers diverted to Mirabel Airport,

- replacement of all existing domestic short haul air services by STOL operations, and

- STOL services operating in competition with conventional services in the short haul market.

A STOL system for shuttling transatlantic charter passengers to and from Mirabel Airport was found not to be practical, due to the number of STOL aircraft movements required to accommodate passengers and baggage from the larger aircraft used on transatlantic flights.

A STOL service for the domestic short haul market, was also examined for its potential relief to Toronto International Airport. As discussed earlier, the short haul domestic sector is only a small portion of the total passenger demand at Toronto International Airport and requires considerably less terminal facilities than other sectors.

While the full impact of STOL diversions has not been addressed in this study, it may be concluded that STOL diversions alone will provide only limited relief to terminal capacity at Toronto International Airport. However, assessment of the degree to which STOL, in combination with other measures, may provide more significant relief to the runways should be evaluated further.

Options such as diverting passengers to airports in Hamilton or London would not be available in the short term due to the limitations of existing air facilities at these cities. On January 30, 1978, the Minister of Transport announced that Hamilton airport is to be upgraded so as to better serve the needs in the Hamilton/Brantford/Niagara area. This may encourage some Hamilton region air passengers currently using Toronto International Airport to use Hamilton airport, thereby providing limited relief. Preliminary studies have explored the potential of diversion to London airport using surface connections from the Toronto area.

Further planning work can and should proceed on STOL options, Hamilton airport and London airport although these will only provide limited relief to Toronto International Airport in the short term. They should be pursued on their own merits.

General Aviation

As indicated in Section 3.3.4, Toronto International Airport is currently a heavily used facility for all levels of general aviation traffic. Effective use of the runway system for larger jet aircraft at this airport will, over time, potentially require constraints on, or diversion of all or part of, the general aviation sector away from the peak periods or to other locations. The estimated full capacity of the runway system is in fact predicated on such diversion.

While studies are underway to determine the impact of general aviation on the existing airspace and runway capacities in the Toronto area, search for alternative locations should also be undertaken.

Studies should be undertaken to investigate alternative locations for general aviation activities currently at Toronto International Airport. Such studies should assess the capability of existing sites as well as new locations, including the potential of the Pickering site.

Long Term Options

Longer term options such as major infield development at Toronto International Airport or development of the Pickering site as a major airport have been briefly reviewed.

An infield (west side) development concept at Toronto International Airport consisting of a 79,000 square metres (or 850,000 sq. ft.) terminal building, access, parking and airside facilities including a possible fourth runway has been estimated to cost approximately $750 million (1977 dollars).

Subsequent to the initial analysis of an infield terminal, the Minister of Transport cancelled the feasibility studies related to the fourth runway at Toronto International Airport. As a result, the ultimate development of an infield terminal associated with a fourth runway is not considered as an option.

The development of an airport on the Pickering (N.T.I.A.) site including a 82,000 square metres (or 880,000 sq. ft.) terminal has been estimated to cost approximately $950 million (1977 dollars)[1].

Both these options would require extensive lead times, in the order of seven years or more, to plan, construct and complete. Given that additional terminal capacity is achieved at Toronto International Airport and that proposed runway and traffic management measures are successful, additional air facilities will not be required before the late 1980's or the early 1990's. Therefore, a decision, with respect to providing these major additional facilities will not be needed before the early 1980's.

A decision regarding major future investments at Toronto International Airport (Malton) and at the Pickering site, other than possibly to proceed with a further expansion of a third terminal, will not be required before the early 1980's if additional terminal capacity sufficient to meet demand until the later 1980's can be achieved at Toronto International Airport. This decision timing is premised on a required lead time for implementation of major facilities of about seven years.

In face of this possible decision and in view of the economic and market uncertainties which will necessitate continuing modifications of the extent, form and timing of improvements to transportation facilities and services, the Pickering site should be retained as a long range option for a major airport.

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[1] Includes terminal, runway, aprons, taxiways, on-site access, support facilities, utilities, equipment, planning and overheads, third party and off-site infrastructure costs.

6.6 Impact Considerations

The preceding sections have outlined the preliminary findings mainly regarding availability and capability of the supply options considered. The various supply options will also have financial consequences of differing magnitudes and create impacts with respect to many aspects, such as energy consumption, industrial and technological development, the environment, regional economy, and others. Preliminary evaluation included estimation of some of these impacts and has been documented in the background reports listed in Appendix B.

The capital cost estimates for major infrastructural alternatives were briefly described in the preceding two sections and are shown for rail in Exhibit 19 and for air in Exhibit 21. More detailed information on costs can be found in the respective background reports.

A complete analysis of the costs of operating the respective intercity modes has not yet been carried out. In particular, no analysis has a yet been done on how the various options involving traffic diversions to other airports and/or modes would affect carrier operations and financial performance. It was noted that, VIA Rail's objective is to reduce its operating deficit on the eleven corridor routes ($66.8 million in 1977). For intercity bus services it was concluded that operators will continue to be capable to respond effectively to fluctuations and growth in demand and hence, retention of commercial viability is presumed. With regard to intercity STOL a related study[1] concluded that an intercity STOL system operating in the corridor could be commercially viable.

A preliminary analysis of energy impacts[2] indicated that strategies involving major traffic diversions to a high speed rail system in an attempt to relieve demand pressures on Toronto International Airport would not

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(1) Transport Canada, Air Transportation Administration, STOL and Short-Haul Air Transportation in Canada, July 1978, p. 61.

(2) Transport Canada, Strategic Planning Group, Estimation of Fuel Consumption for Preliminary SOMPS Supply Strategies, August 1979.

necessarily bring about major savings in energy consumption. One of the main reasons is that air passenger diversion to other modes affects only a relatively small portion of total air travel to and from Toronto. It was also noted that future fuel savings would result mainly from the anticipated introduction of improved technologies in intercity modes in the 1980's, rather than from modal diversions.

Each of the physical supply options will have different industrial/technological impacts in terms of additional direct sales, export sales, employment creation and technological spin-offs for the transport equipment and construction industries in Canada. Analysis of these impacts has not been finalized. There are, however, indications that options such as STOL and high-speed rail could generate substantial long run industrial/technological impacts in the aerospace manufacturing and railroad rolling stock industries in Canada. Options involving expanded or new airport facilities would mainly benefit the engineering construction sector in the period (up to five years) during which these facilities would be under construction.

A preliminary analysis of environmental impacts of supply options for the air mode was undertaken with respect to ecological impacts from airport construction. (Volume 11A of the S.O.M.A.T.S. Study Reports listed in Appendix B.) This work concluded for example, that the construction of a new international airport at the Pickering site would have greater potential ecological consequences than most of the other airport development alternatives studied. It was also found that the construction of a new terminal on the east side of Toronto International Airport (within the present airport boundaries) will not create any significant negative ecological impacts.

Detailed evaluation with respect to noise impacts resulting from airport operations is currently underway. The magnitude of the impacts will depend largely on the types of aircraft used in the future and on the operating procedures. Due to the expected gradual replacement of noisier aircraft by quieter equipment, the noise impacts on areas surrounding airports are likely to be less than previously anticipated.

More detailed analyses and evaluations of these and other impacts are to be carried out as part of the ongoing planning process. Chapter 7 describes how the evaluation work will be incorporated in the planning and decision process.

7. THE DECISION POINT PROCESS

7.1 Introduction

This report is not advocating some new planning process. Rather it stresses, more than ever before, that there is a need to recognize the uncertainties associated with determining future intercity passenger transportation facility requirements. Previous chapters have described the limitations inherent in forecasting future travel demands. There are also further uncertainties related to the improvement options in terms of their timely availability, their ability to accommodate travel, and their financial viability.

This situation suggests that it is not desirable to establish a definite long range plan and make corresponding long range commitments at this point in time, but rather to develop a flexible process which permits adaptions to changing circumstances, within the context of defined supply options and continuous updating of existing ranges of demand forecasts.

The following sections describe a planning and decision approach, the Decision Point Process, which will assist in determining, to the greatest extent possible, the form, magnitude and particularly the timing of future transportation requirements.

Although this process will not eliminate the potential impacts resulting from future uncertainties, it nevertheless will contribute to reduction of the risks which always will be associated with major transportation investment decisions.

The pursuit of the planning and decision process implies the acceptance of a basic set of principles. These principles include:

a) opportunities to re-assess information prior to each decision point, such as:

   - recent and expected developments in external factors influencing travel demand

   - degree of success from previous system optimization and improvement measures

- the capability of new technology available at that time or expected in the future

- the type and level of service deemed appropriate for both the short and longer term following the decision;

b) deferral of major decisions as long as prudently possible. This is particularly important when facing decisions, which could potentially result in large capital investments or which may severely limit future flexibility. It implies also that higher priority will have to be given to maximizing the usage of existing transportation facilities;

c) incremental commitments to be made with an understanding of the longer range implications of such commitments in terms of useful lifetime, return on investments and degree of resultant flexibility;

d) recognition of the significant lead times for implementation of major facilities.

In order to accommodate these features effectively, the process must be accompanied by a continuous planning process which will provide the necessary analytical work and which in conjunction with the decision point process itself will determine the appropriate timing of decision points. This timing must also take into account the lead times required to plan and implement potential measures such as airport or rail line construction, equipment procurement and procedural changes.

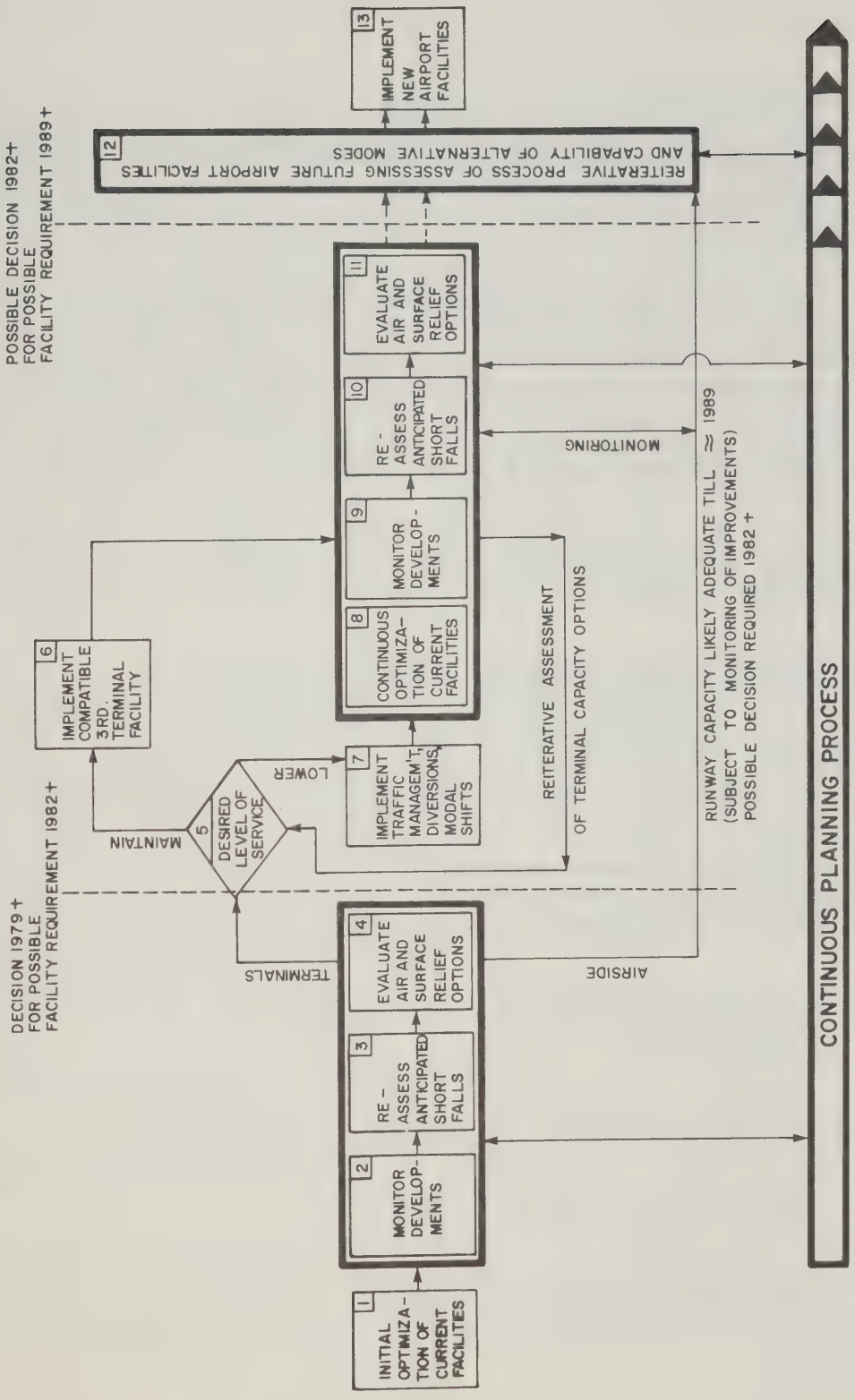
7.2 The Decision Point Process

Exhibit 22 describes schematically a planning and decision process for dealing with the anticipated problems at Toronto International Airport. The exhibit covers primarily the components associated with the decisions which are expected to be required in the short term, and suggests the recurring nature of these steps for dealing with future improvement decisions.

Boxes 1-11 indicate the Decision Point Process elements that are currently being considered and implemented as well as those which are likely to require consideration in the short to medium term.

EXHIBIT 22

SOMPS - TORONTO INTERNATIONAL AIRPORT - DECISION POINT PROCESS
(SIMPLIFIED DIAGRAM)



Boxes 12 and 13 are longer range considerations which include reiteration of the optimization, monitoring and evaluation functions indicated earlier in order to derive appropriate solutions to future transportation service requirements.

Box 13 indicates the implementation of new airport facilities when all other options within the transportation system have been exhausted in accordance with the level of service which has been deemed desirable and appropriate. An alternative airport for Toronto may then be necessary if a continued air service is to be provided for the additional growth in travel beyond that time.

A detailed discussion of the components of the Decision Point Process (by box number) is given in the following sections.

Box 1, Optimization of Current Facilities

This step represents the ongoing optimization of the existing facilities at Toronto International Airport as carried out in the day-to-day management of the facility and as recommended in the Toronto International Airport Contingency Plan. It includes elements which may emerge as experience with new operating procedures or new technology becomes available. Specifically, ongoing optimization involves consideration of the following:

- inter-terminal traffic transfer taking into account the differential effects of on-time performance by traffic sector,

- changes in Immigration and Customs procedures to smooth passenger flows and reduce delays,

- possibility of using enroute flow control to smooth demand on terminal facilities,

- possibility of changing passenger processing arrangements on departure to reduce passenger time in the terminals,

- examination of the 90th percentile planning standard in light of the smoothed traffic profile that may result from enroute flow control and other possible measures. Examination of the appropriateness of a standard that defines level of service in terms of probability of delays,

- measures affecting general aviation as required during peak periods to ease runway problems,

- use of time-slot scheduling/enroute flow control to ease runway problems,

- encouragement of off-site parking and shuttle bus services to ease access problems to Toronto International Airport,

- improvement of transit access to ease ground access congestion,

- assessment of the implications for peak hour traffic growth of encouraging "Nighthawk" and other off peak incentive fare operations,

- continued efforts to distribute traffic more evenly throughout the day and the week,

- feasibility of modest facility additions e.g. an arrivals holding lounge possibly to accommodate passengers of poor on-time performers till processing capacity is available,

- feasibility of using bilateral air agreements review to offer time slots to new airlines in off peak periods, thereby reducing pressure on airlines operating in peaks,

- partial pre-processing of passengers in a terminal remote from the main airport facility,

- modifications and additions to taxiway system,

- adjustments to the allowable crosswind component (New procedures implemented March 23, 1979),

- improved air traffic control,

- further use of other airports in the region for passengers destined to the respective areas (e.g. Hamilton and London),

- increased direct flights within the national air transportation system as these become viable, in order to reduce intermediate stops and transfers at Toronto International Airport.

Many of these measures are being or will soon be implemented. Others may be introduced gradually over time in parallel with potential major capital investments and remain important considerations throughout the entire decision point process.

The success of these optimization measures in deferring other more capital intensive improvements is yet uncertain and such modifications must be subject to testing in practical operations to determine their effectiveness. This implies that the decision process must provide for contingencies in terms of physical solutions in the event operational and procedural modifications do not yield the desired capacity increases.

Box 2, Monitoring of Developments

The monitoring process examines, on a continuous basis, the developments in travel demand as well as the capability of the existing transportation modes and facilities. This includes:

- updating of information on external factors influencing the transportation sector, e.g. social, demographic and economic variables,

- review of current policies with respect to fares and regulations,

- review of the success of system optimization measures (from Box 1),

- review of recent and expected developments in technology within the respective travel modes, and

- inventory of up-to-date information on existing and expected future travel.

Box 3, Reassessment of Anticipated Capacity Shortfalls

On the basis of the monitoring process and the continuous planning process, a review of the type and timing of future capacity shortfalls within the system can be undertaken. This assessment identifies where in the system pressure on facilities is likely to occur next, and thereby suggests the areas which must receive primary attention in order to maintain a practical balance throughout the system.

For instance, at Toronto International Airport, consideration must be given to the compatibility of capacities between runways and terminal buildings.

Box 4, Evaluation of Air and Surface Relief Options

The evaluation of available options to solve anticipated capacity shortfalls is a function of the continuous planning process. It takes place at critical points through time when decisions or further course of action appear to be required. The evaluation information forms the basis for making decisions with respect to the level of service that is deemed desirable and appropriate at each point in time.

This evaluation includes the assessment of available options within the air mode, both airside and groundside, as well as a review of the potential of the surface modes to provide relief to the pressure on the air facilities.

All procedural and physical options within the respective modes are being evaluated on the basis of criteria such as:

- cost/expenditure
- system capability
- system availability
- regional economic impacts
- industrial/technological impacts
- environmental impacts
- sensitivity of decisions to future uncertainties
- energy impacts
- freight transport impacts
- impacts on operations
- legal/policy impacts
- impacts on level of passenger service.

This evaluation must be completed for both the short term options subject to any immediate decisions and the longer term options that will remain as a result of any immediate decision.

A preliminary evaluation of some supply options was carried out in terms of costs, availability and capability and resulted in the elimination of some components (see Section 5.3). The main conclusions are given in Chapter 6.

Box 5, Level of Service Decision

The decisions as to the appropriate levels of service within the respective modes are of major importance to both the magnitude and timing of additional facilities and operational modifications, and must be dealt with prior to major decisions.

While levels of service can not be categorized in distinct classes, two basic types were chosen for the purpose of the diagramatic illustration. They imply two major kinds of action which are not necessarily mutually exclusive; in real life they will probably proceed to some extent in parallel.

a) Maintenance of Existing Level of Service implies that the level of congestion and delays experienced today will be generally adhered to, with some additional spreading of traffic to the shoulders of the peaks, but should not impose any major restrictions on air travel over and beyond what is the case at present. This option would suggest implementation of physical expansions within the air system.

b) Lower Level of Service implies a tighter traffic management policy which imposes restrictions on air travel relative to today's situation. This may include peak spreading which will significantly alter the present arrival and departure patterns, diversion of some flights to alternate airports, as well as serving certain destinations by ground transportation modes. The passenger rail mode, in particular, should be reassessed at each evaluation point to determine the level of its service improvements and ability to provide a reasonable alternative service.

More detailed analysis is required in order to establish more refined definitions of level of service, both within the air mode and in a multimodal system context. Furthermore, the analysis must also deal with the implications of adopting different levels of service for planning purposes, as well as impacts on the operators and the travelling public.

Box 6, Implementation of Compatible 3rd Terminal

This step implies construction of additional terminal facilities at Toronto International Airport in order to balance and utilize the capacity of existing runways. This may involve the building of a temporary, full scale or an initial phase of a full scale terminal depending on the runway capacity available, the associated costs, and the anticipated time span before the capacity of the alternative terminal configurations is exceeded by demand.

Box 7, Implementation of Traffic Management, Diversions and Modal Shifts

As indicated above, these measures imply actions that are likely to lower the level of service as compared to today's situation. Consideration will be given to the re-scheduling of arrivals and departures to achieve a substantially more even demand on the facilities over the day and week. The diversion of air traffic away from Malton is another possible measure and may include:

- replacement of CTOL operations by STOL services utilizing other airport facilities,
- diversion of some flight sectors, for example charter traffic to other airports with available capacity on a temporary or a permanent basis,
- diversion of general aviation traffic to other facilities in the region.

Modal shift considerations will include assessments of the development of bus and rail services over time and their capability to serve some of the domestic short-haul traffic as an alternative to air services.

Boxes 8-11, Short to Medium Term Considerations

As indicated in Exhibit 22, there will be a need for a reiterative assessment of terminal capacity options in the short to medium term. Boxes 8-11 indicate the recurring planning work that will be undertaken in support of decisions subsequent to the first major decision.

Over this period, several consecutive decisions, such as indicated by Box 5, may be required. The nature of these subsequent decisions will depend on the type of action chosen at the first major decision point as follows:

a) If the first major decision is to proceed with an initial third terminal building the subsequent decisions may include consideration of a subsequent phase of this terminal and/or introduction of further traffic management measures.

b) If the first major decision involves traffic management actions rather than construction of a new terminal building, the subsequent decisions may include further pursuit of these management measures and/or construction of an initial third terminal building.

As indicated earlier, the existing runway system at Toronto International Airport will likely be adequate until at least the late 1980's. This potential capacity is, however, premised on the success of a number of operational measures and must be monitored as these measures are implemented.

This monitoring will provide a basis for determining the timing and the type of terminal solutions which will provide cost-effective improvements compatible with the capacity of the runway system.

This continuous review of the runway system capability will also ensure that decisions regarding runway requirements are considered at the appropriate time with due regard for the lead times required for implementation of new facilities.

7.3 Decision Point Time Schedule

In order to be applied effectively, a decision point process should, immediately prior to a decision point, be supported by an up-dated timetable which would indicate the various critical points in time when the decision makers must draw upon the planning process, re-evaluate the urgency of decisions or initiate system modifications as necessary. Considerations for implementation lead times and the requirement for maintenance of flexibility in the decision process will have a significant influence on the timing of these critical points. The critical points represent the early warning schedule as to when a major systems evaluation must take place and when implementation timing if any must be defined.

Decision point timetables should be developed along with the Decision Point Process and updated correspondingly as the planning process provides continuous data on actual system performance.

The new forecasts developed in the Southern Ontario Multimodal Passenger Studies have not yet been detailed to a level sufficient for actual facility planning. Thus it is not possible at this time to develop a decision point timetable based on the latest growth patterns and range of possible new forecasts. The impacts of operational modifications currently underway and recommended (Box 1) have also not been fully explored and evaluated. All of this will be part of future work.

However, recent planning work in relation to Boxes 2, 3 and 4 carried out in the context of the federal Southern Ontario/Montreal Air Transportation Study (S.O.M.A.T.S.), on the basis of the 1975 forecasts, indicates that it will be necessary in the latter part of 1979 to consider the need for decisions regarding additional terminal facilities at Toronto International Airport (Box 5). The options to be considered at that time will include:

- further deferral of decision
- implementation of additional management measures (Box 7)
- implementation of a third terminal (Box 6).

In preparation for this first major decision point, it is recommended to continue with conceptual planning and definition of operational requirements for a third terminal.

Planning work should also continue with respect to the remaining supply options (STOL services, Hamilton Airport, London Airport, general aviation airport alternatives, moderate high-speed rail, etc.) since these options will need to be evaluated in conjunction with the third terminal option prior to the decision (Box 5).

The recent planning work by S.O.M.A.T.S. also indicates that further decisions on major expansion at Toronto International Airport or on a new airport, can be deferred until after 1982. This is again based on the 1975 forecasts, (which, on an annual basis, are only slightly higher for the short term than the new high forecasts), and is premised on measures being implemented at Toronto International Airport to provide adequate terminal capacity until at least 1989.

However, these decision point dates are subject to continuous review and changes are possible. They will greatly depend on the success of ongoing operational changes as well as on the level of service which is deemed appropriate at the time decisions have to be made. Earlier decision dates may be required if the periodically revised forecasts exceed the growth indicated by the current forecast range.

7.4 Summary

The Decision Point Process provides a basis on which delivery of transportation services may proceed with the opportunity for continuous re-evaluation of the possible available options and the determination of desired and appropriate levels of service as these factors change with developments both internal and external to the transportation sector.

It provides a framework for deferral of expenditures as long as prudently possible and allows planning flexibility through the opportunity for incremental commitments to be made as close as possible to the time required.

The process also enables these incremental decisions to be made with an understanding of both short and long term implications, thereby providing a basis for maximizing the return on investments.

For the main issue addressed in this report and based on the preliminary findings of the studies, it can be concluded that the first decision regarding a possible third terminal will be required within the next twelve months. Decisions concerning major facilities for the long term, other than possibly to proceed with a subsequent phase of a third terminal at Toronto International Airport, can be deferred until the early 1980s. The specific dates will, to a great extent, depend on the success of ongoing and future incremental improvements in the airport system and surface modes over the next few years. A first review of the decision dates for the major long range investments will take place in the context of the first decision on a third terminal for Toronto International Airport.

8. NEED FOR FURTHER ANALYSIS

8.1 Study Status

While not all analysis work is complete, this report has outlined a number of specific findings and conclusions concerning intercity passenger transportation requirements in Southern Ontario, with emphasis on the Toronto International Airport issue (Chapters 4 and 6). Annual forecasts were reviewed and updated for the Toronto International Airport, taking into account possible impacts from improvements at other airports and in other modes. The important relationships that exist between socio-economic factors and travel growth were recognized. A wide range of possible supply options was identified and underwent a preliminary evaluation.

Chapter 7 described a suggested planning and decision process which will emphasize the need for flexible and incremental planning in face of the many uncertainties in the future. To fulfill this process requires the examination of all relevant information prior to each decision point.

As previously indicated, initial optimization of the existing facilities at Toronto International Airport is being undertaken as part of the day-to-day management of the facilities, as well as a result of the findings of the Contingency Plan Study. In addition, a recently completed technical study has concluded that it is feasible to construct a third terminal building on the east side of the existing airport site. Planning work in relation to the requirements indicated in Boxes 2, 3 and 4, Exhibit 22 is also underway, but will require completion in accordance with the further work outlined in the following sections.

8.2 Further Analysis

A continuous process of review, update, and where necessary, refinement of study findings will accompany the Decision Point Process so that each decision will be made on the most current and complete information available.

8.2.1 Information for First Major Decision

Preliminary analysis, based on forecasts developed prior to this study, has indicated that a decision will be required within the next twelve months with respect to additional terminal capacity at Toronto International Aiport.

In preparation for this first major decision point, one of the most important study tasks is to establish an updated probability range of estimated dates for when Toronto International Airport terminal and runway elements will be operating at capacity (Box 3 of the Decision Point Process).

This work will include:

a) The completion of the detailing of the new air travel demand forecasts to provide information on planning peak movements of aircraft and passengers, including the definition of various degrees of peak spreading which then will be subject to evaluation as to impact on operations and service to passengers.

b) The incorporation of effects on forecasts of recently introduced incentive air fares and anticipated fuel price increases.

c) The assessment of the effect of operational and management measures that may be introduced prior to the estimated implementation time for major new facilities.

In conjunction with the re-assessment of the anticipated capacity shortfalls, further planning work should be completed on the possible supply options, in particular with regard to the following:

a) A third terminal at Toronto International Airport:

The technical feasibility of constructing and operating a third terminal at Toronto International Airport has already been determined. It is necessary for the first major decision point to complete terminal planning work in terms of conceptual planning (role assignment, capacity ranges, etc.) and definition of operational requirements which will influence the actual size and design of the terminal.

b) Moderate passenger rail improvements:

A preliminary assessment of a very high speed rail option with respect to its potential to relieve the air mode was completed. However, further evaluation should be carried out to determine the feasibility of more moderate operational and technological improvements in the Quebec City-Windsor corridor on their own merits and to determine if, in combination with other measures, this mode could contribute in any cost-effective way to the deferral of Toronto International Airport's capacity problems in the longer term.

c) Intercity STOL services, Hamilton and London Airports, the role of Mirabel Airport, and possible alternative locations for general aviation:

Other air system and facility improvement options should also be further analyzed to determine their likely combined contribution to capacity problem solutions in the air mode. This will include the completion, prior to the first major decision point, of the planning work on intercity STOL services, Hamilton airport, London airport, the role of Mirabel airport, and investigations into alternative airport locations for general aviation currently using Toronto International Airport.

In addition, the evaluation of these supply options in terms of the evaluation criteria listed in section 7.3 must be continued to completion, particularly with regard to such aspects as cost recovery, energy consumption and environmental impacts.

8.2.2 Analysis in Support of the Continuous Planning Process

While the present emphasis is on completion of analysis work already underway in view of the upcoming decision point concerning a third terminal, the Decision Point Process in general is to be accompanied by a continuous planning process which will produce the necessary analytical information for further decision points.

The Decision Point Process also suggests the continued search for, and evaluation of, additional and improved supply options.

Chapter 4 indicated that travel demand is sensitive to changes in social and economic factors. Hence, it is necessary to monitor and assess developments with regard to these external factors, as they may affect both the demand for travel and the ability to improve transportation services. Passenger forecasts will need to be updated accordingly.

It will also be necessary to monitor developments within the respective intercity transportation modes. The report has assessed current modal system conditions and capabilities (Chapter 3).

In the airmode, continued developments in such areas as domestic charters, promotional fares, changing regulations and new aircraft technology could have significant impacts on the type, timing and management of air facilities.

With respect to the rail mode, new developments in passenger rail operations and technology should be monitored. In particular, further evaluation should be carried out to determine the feasibility of high-speed improvements in the Quebec City-Windsor corridor in the longer term.

The capability and future market share of the bus mode should also be monitored. While no major technological changes are expected within this mode through the next 10-15 years, its competitive position in the intercity transportation system should be subject to periodic evaluation. The relative fare levels in the bus and rail modes will be of particular concern, and the level of operating subsidies provided for the rail mode will need to be assessed as further information on the performance of these two modes becomes available.

Level of Service Aspects

One of the most fundamental features of the suggested Decision Point Process is that prior to each major decision point, the affordable level of service in each of the intercity modes must be re-evaluated. This will require continued assessment of the impacts of various levels of service in the context of prevailing government priorities and financial capabilities.

Among other things, level of service is reflected by delays, congestion within facilities, and the degree of choice of departure and arrival times. Further research must be carried out, particularly for the air mode, to determine the actual impacts of such aspects as peak spreading and deferred provision of additional terminal space.

8.3 Conclusion

The Decision Point Process, as outlined in this report, provides for a flexible and incremental approach in the provision of intercity passenger transportation services. It does not provide a single long range plan; it implies a continuous planning process, consisting of monitoring, evaluation and re-assessment of the type and timing of transportation requirements prior to decision points.

This chapter outlined the need for further analysis in support of the Decision Point Process, first the need to complete analysis and planning work in preparation for the first decision point and, second, the need for continuous planning in support of subsequent decisions.

GLOSSARY OF TERMS

Average Annual Daily Traffic (A.A.D.T.)	The yearly volume of vehicles passing a given point on a highway divided by the number of days in the year.
Air Carrier	In this report, anyone or any corporate entity licensed by the CTC to transport passengers, mail and/or goods in aircraft over 18,000 lbs. and having an official ICAO or Transport Canada designator such as Air Canada, Air France, Wardair, etc.
Aircraft Movement	A take-off, landing or simulated approach by an aircraft.
Aircraft Separation	The spacing between aircraft in flight, altitudes or track. This is accomplished by assignment by ATC of specific altitudes and tracks to aircraft. Between aircraft at the same altitude and on the same direction tracks the spacing is determined by time (minutes).
Airside	The subsystem of an airport which provides the means for the operation and maintenance of aircraft. It includes such facilities as runways, taxiways, gates, aprons, aircraft holding areas, aircraft servicing and maintenance areas and the air traffic control system (Compare: Groundside).
Airspace, controlled	An airspace of defined dimensions within which air traffic control services are provided.
Air Traffic Control (A.T.C.)	The traffic control system which directs the movement of aircraft. This service is provided for the purpose of 1) preventing collisions a) between aircraft and b) in the manoeuvring area of an airport between aircraft and obstructions and 2) expediting and maintaining an orderly flow of air traffic.

Airway	A designated airspace in which ATC services are provided. In the low level airspace (below 18,000 feet ASL) a prescribed track between specified radio aids to navigation along which air traffic control is provided. In the high level airspace (above 18,000 feet ASL) a prescribed track between specified radio aids to navigation along which air traffic control service is provided.
Arriving and Departing Passengers	Term used in air transportation statistics which encompasses all air passengers using an airport, i.e. it includes: - origin and destination (O-D) passengers - connecting passengers, and - transiting passengers. Generally, only revenue passengers are included.
ASL	Above Sea Level.
Bilateral Air Agreement	An intergovernmental agreement between two countries on the exchange of commercial rights in international air transport.
CATA	Canadian Air Transportation Administration.
Charter Service	A type of transportation service operated in accordance with a licence to offer public transportation at a toll per mile or per hour for the charter of an entire vehicle, or at such other tolls as may be allowed by the licensing authority such as the Canadian Transport Commission. Charter air services are operated irregularly and usually require booking a pre-specified time prior to aircraft departure and/or the purchase of a package of accommodation and meals along with air transport. Compare: Scheduled or Mainline Unit Toll.

Classes, air services	The classification of commercial air services provided under licenses of the CTC's Air Transport Committee are as follows:
Class 1	Scheduled commercial air service, being a service that is wholly within Canada and that is required to provide public transportation of persons, goods or mail by aircraft, serving points in accordance with a service schedule at a toll per unit of traffic.
Class 2	Regular Specific Point commercial air services, being a service that is operated wholly within Canada and that is required to provide, to the extent that facilities are available, public transportation of persons, goods, or mail by aircraft, serving points in accordance with a service pattern at a toll per unit of traffic.
Class 3	Specific Point commercial air service, being a service that is operated wholly within Canada and that offers public transportation of persons, goods or mail by aircraft, serving points consistent with traffic requirements and operating conditions at a toll per unit of traffic.
Class 4	Charter commercial air service.
Classes 8, 9-2 9-3 and 9-4	International Service.
Connecting Passengers	Passengers who change flights at the airport but who do not normally leave the airport boundaries.
Corridor	In this study, the series of large urban centres along the geographic axis extending from Detroit/Windsor to Quebec City and including Toronto, Ottawa and Montreal.

Crossings	In this report, the facilities and structures enabling the safe crossing of a railway right-of-way either at the same level or at a separated level (tunnels, underpasses and bridges).
Crosswing Component	The resultant effect of current wind velocity and runway direction acting at right angles to the direction in which aircraft take-off or land, usually measured in knots (nautical miles per hour).
CTC	Canadian Transport Commission.
CTOL	Conventional Take-Off and Landing Aircraft.
Dependent Runway Operation	See Runway.
Domestic Travel	Travel wholly within Canada.
Enplaned and Deplaned (E-D) Passengers	Term used in air transportation statistics which encompasses the total of passengers with origin or final destination at an airport plus connecting passengers.
Enroute Flow Control	The control of the movement of aircraft along an airway while at considerable distance from an airport.
Extra-Regional Travel	Travel to and from places outside the Southern Ontario region as defined in this study (Synonym: Inter-Regional Travel).
Flight Path	The space in the air through which an aircraft moves from take-off to landing.

Flight Sector or Segment

Statistical category used in air transportation to denote different types of traffic. In this report, air passenger traffic has been segmented according to the following categories:

- short-haul and long-haul
- scheduled and charter
- Domestic, Transborder and other International.

G.A. - General Aviation

Segment of aviation activity performed by aircraft other than air carrier (i.e. generally other than commercial air carriers providing Class 1 and 2 air services), military and heavy charter aircraft. It includes all flying activities conducted by training organizations, private business, recreational and individual commuting flying. In this study the definition has, however, been expanded to include as well certain segments of charter and other commercial flying by commercial carriers. (See: SOMATS Reports).

Greeters/ Wellwishers

Term used in air transportation statistics to describe persons other than air travellers who come to an airport for the primary purpose of meeting or seeing-off air travellers.

Groundside

The sub-system of an airport which provides the means of interchange, for both passengers and goods, between ground transport and air transport. It includes such facilities as terminal buildings, parking areas and structures and the road system on airport property (Compare: Airside).

High-Speed Rail	In this report, a passenger train operating at station-to-station speeds of more than 150 km/h (90 mph). For speeds over 200 km/h (125 mph) the term very-high-speed rail is used.
Holding Lounge	The area within a terminal building which holds air passengers who have been ticketed and had their luggage checked-in and are waiting to board on aircraft.
Hub Airport	An airport that by virtue of the size and economic importance of its catchment area offers a great number of flights to and from many destinations thus attracting many connecting passengers. Airlines often choose to have major maintenance and repair facilities located at such hub airports.
ICAO	International Civil Aviation Organization, Montreal.
IFR	Instrument Flight Rules, rules and procedures for the operation of aircraft without visual reference to the ground in both, the controlled and uncontrolled airspace, where aircraft are under the directional guidance of and/or receive flight information from air traffic control service.
Incentive Fare	A fare lower than the regular (standard, economy or coach) fare offered by a carrier to create a price incentive for travel on certain routes and/or at a certain period of the day, week or year.
Infield Terminal	The new passenger terminal building which according to one of the preliminary supply strategies in this study (Strategy 3) was to be located on the west side of T.I.A., between the existing 14-32 runway and a proposed new parallel 14-32 runway.

International Travel	Travel between Canada (in this study between the Southern Ontario region) and other countries. If reference is exclusive of travel to and from the United States (Transborder Travel) the term "Other International" is used.
Inter-Regional Travel	Travel to places outside the Southern Ontario region as defined in this study and for which in some instances the prime mode is air transportation (Synonym: Extra-Regional Travel).
Independent Simultaneous Runway Operations	See Runway
Intercity Travel or Transportation	All travel or transportation of passengers to and from urban destinations of more than 80 km (50 miles) that is not within the same urban area. It also excludes travel to, from and between rural destinations, but includes international travel.
Knot	The traditional measure of speed at sea and in the air, equalling a nautical mile per hour. A nautical mile is 1,852 m. (1.15 statute miles).
Level of Service Airports	The quality of the transportation service received by the user which can be expressed according to certain attributes such as safety, on-time performance, comfort, congestion, etc. For airport terminals, the level of service is expressed, for example, in terms of the delays experienced by passengers and aircraft due to capacity limitations in the system. It is customary to establish the level of traffic to be accommodated as a percentile of the traffic demand ranked on a daily or an hourly basis.

Long-Haul	Any transportation over 800 km (500 miles).
Long-Haul air Passenger Transportation	Has been defined in this study to include all inter-regional passenger travel by air over 800 km (500 miles) and includes the following travel segments: - scheduled Domestic air travel over 800 km - scheduled Transborder air travel over 800 km - scheduled Other International air travel - all International charter air travel over 800 km.
LRC Trains	Light, Rapid and Comfortable trains; developed by Bombardier - MLW featuring tilting body coaches which permit higher operating speeds up to 200 km/h (125 mph) on existing track and thereby eliminating extensive track improvements.
Mainline Unit Toll	That type of unit toll operation carried out by Air Canada, CP Air, the five regional air carriers (Eastern Provincial Airways, Quebecair, Nordair, Transair and Pacific Western Airlines) and foreign carriers. It implies the use of large aircraft and regular service which is listed in a published timetable and is performed according to a filed service pattern.
Moratorium	A temporary governmental measure introduced for Toronto International Airport which postpones negotiations regarding access by additional foreign airlines. The moratorium was instituted in May 1976 after the construction of N.T.I.A. Pickering was halted, and is to be reviewed in 1980.
MOT	Ministry of Transport (Transport Canada).

MSUA	Ministry of State for Urban Affairs, Ottawa.
MTC	Ministry of Transports and Communications, Ontario.
Nighthawk Fare	A special Air Canada fare available on a year-round basis for travel on some routes with flights departing during the late (after 9:00 p.m.) hours of the day. CP Air has a similar service called "Courier".
NTIA	New Toronto International Airport (at Pickering).
Offsite Parking	Parking of motor-vehicles in areas or structures not located on airport property.
Origin and Destination (O-D) Passengers	Those passengers who have their origin or final destination in the geographic area in question.
Other International Travel	Travel between Canada and another country other than the United States. Compare: Transborder Travel.
Peak Hour	The period of one hour's duration in the 24-hour day during which the greatest amount of traffic occurs. In practice it is usual to distinguish morning, midday or evening peak-hours. See: Planning Peak Hour (Day).
Peak Hour Princing	At airports the policy by which user charges such as aircraft landing fees are kept at higher levels during peak hours than during the rest of the 24-hour day.
Peak Period	The specific period during a day, week or year where traffic volumes are considerably higher than during the rest of the observed time period. See: Planning Peak Hour (Day).

Peak Spreading	Traffic management which utilizes measures such as peak hour pricing or time slot scheduling to discourage further accumulation of traffic during the busy peak periods and encourages the rescheduling of arrivals and departures to off-peak periods.
PERAM	A multimodal forecasting and simulation model developed by the Strategic Planning Group of Transport Canada which handles passenger origin-destination trips for all modes on a (currently only domestic) city-pair active basis.
Personal Real Disposal Income (PRDI)	The income of all persons in a country after tax and after accounting for inflation.
Person Trip	A trip taken by each person for example, if a family of four takes a trip together, four person-trips are made.
Planning Peak Hour (Day)	In airport planning, the volume of air traffic used for the planning and design of facilities. The volume level chosen lies between the average volume and the highest (peak) volume in an hour (day). Transport Canada presently defines the planning peak hour (day) passenger volume for major airports according to the 90th percentile of the annual distribution. This can be interpreted to mean that over the period of a year 10% of the passengers passing through an airport will experience a service level worse than that used in the design of the facility.
PODM	Passenger Origin - Destination Model. An econometric model developed by the Canadian Air Transportation Administration which forecasts, on a national basis, the number of origin-destination air passenger trips between pairs of geographic areas (zones).

Preclearance	An air passenger processing method whereby international passengers pass through customs and immigration control at airports other than their final destination airports.
Profile Descent	See: Standard Descent Profile.
Propensity Model	An air passenger forecasting model developed by the Air Transportation Administration of Transport Canada which forecasts origin destination air trips to and from a specific airport, in this study Toronto, using trip generation rates (propensities for travel) calculated for each socio-economic group of travellers and each flight segment.
PTV	Passenger Transfer Vehicle, used at some airports to move passengers from terminal gates to parking aircraft.
Rapido train	Non-stop train operating between Montreal-Dorval-Kingston-Guildwood-Toronto using conventional 1955 equipment. Total scheduled travel time: 4 hours and 55 minutes. Station to station speed: About 110 km/h (72 mph).
Regulatory Change	The change of existing economic regulations pertaining to air carriers which restrict their operating flexibility (setting of tariffs, seat capacities, in-flight service requirements, selection of destination, etc.).
Revenue Passenger	A person receiving transportation from a transport carrier for which remuneration amounting to at least 25% of the normal fare is received by the carrier.
Role Assignment, Terminals	In this study, the allocation of certain flight sectors and/or airlines to a specific terminal building at an airport with several terminals.

Runway, Dependent Operation	A situation where, as the result of airfield geometry and operational procedures, aircraft take-offs and landings must be fully coordinated by air traffic control even when several runways are available.
- Independent Simultaneous Operation	A situation where aircraft take-offs and landings at an airport with more than one runway can take place at the same time and independently from each other. Each runway is operated as a separate entity.
Scheduled Service	A type of transportation service that is operated on a regular basis according to a published timetable. In air transportation the expression Mainline Unit Toll is also used.
Scenario, Socio-Economic	A package of consistent assumptions for selected socio-economic factors such as population and income and on how they will change in the future.
Seat Mile	A statistical unit used in passenger transportation statistics to describe the maximum capacity provided on a system by multiplying the number of the seats available per vehicle with the number of miles travelled by this vehicle in a year over a route regardless whether these seats were occupied by passengers or not.
Short-Haul	Any transportation under 800 km (500 miles).
Short-Haul Air Passenger Transportation	Has been defined in this study to include all regional and inter-regional passenger travel by air under 800 km (500 miles) and includes the following two travel segments: - scheduled Domestic air travel under 800 km (500 miles) - scheduled Transborder air travel under 800 km (500 miles).

Simulated Approach	An instrument landing approach procedure conducted in visual flight conditions by an aircraft not on an IFR clearance; mainly used for pilot training.
SOMATS	Southern Ontario/Montreal Air Transportation Study, undertaken by the Air Transportation Administration of Transport Canada to examine, in support of SOMPS, how the Southern Ontatio/Montreal airport system can best meet travel demand of the 1980s and beyond.
SOMPS	Southern Ontario Multimodal Passenger Studies.
South	In this report, denotes a flight sector that includes all air travel from and to places south of the United States, including the Caribbean, Mexico, Central and South America.
Standard Descent Profile	The uninterrupted descent of an aircraft from cruising altitude to the interception of a glide slope or to a minimum altitude specified for the initial or intermediate approach segment of an instrument (IFR) approach to an airport.
STOL	Short Take-Off and Landing aircraft.
Taxiway	The paved areas on the airport which enable aircraft movements between runways and terminals as well as between terminals.
Tempo Trains	Passenger trains operating between Toronto and cities in south-western Ontario using conventional 1955 equipment. Total scheduled travel time Toronto-Windsor: 4 hours and 5 minutes or more. Station-to-station speed: about 70 km/h (43 mph).
TIA	Toronto International Airport at Malton (City of Mississauga).

Time Slot Scheduling	A scheduling procedure under which the airport authority would, in close co-operation with the scheduled and charter air carriers, specify arrival and departure times for certain flights so that peak passenger flows are spread, insofar as possible, into other time periods.
Toronto International Airport Contingency Plan Study	Study of Toronto International Airport at Malton to identify and evaluate suitable courses of action which would enable the airport to operate effectively until at least 1982 without expansion of the airport or provision of alternative major airport facilities within that time period. Also called: Malton Contingency Plan Study.
Turbo Train	Non-stop train operating between Montreal-Kingston-Guildwood-Toronto using turbo jet power technology. Total scheduled travel time: 4 hours and 30 minutes. Station-to-station speed: 120 km/h (75 mph).
Track	In aviation, the projection of the flight path of an aircraft on the earth's surface, the direction of which path is usually expressed in degrees from North (true, magnetic, compass or grid).
Transatlantic Travel	Travel spanning the Atlantic Ocean where the origin is in Canada and the destination in Europe, Africa or the Middle East, or vice versa.
Transborder Travel	Travel between Canada and the United States. Compare: Other International Travel.
Transit Access	Land access to an airport by public modes of transport other than taxi or limousine, including buses and rail transit systems.

Transiting Passengers	Passengers whose aircraft happens to stop at the airport, but who do not normally leave the aircraft. Compare: Connecting Passengers.
Trip	A one-way journey between a point of origin and a point of destination.
VIA Rail	Via Rail Canada Inc., the newly established federal crown corporation responsible for the operation of all passenger rail services in Canada.
VFR	Visual Flight Rules, rules and procedures for operation of aircraft with visual reference to the ground or water, unless otherwise authorized by an air traffic control unit.

INVENTORY OF

TECHNICAL BACKGROUND PAPERS

This inventory lists all reports on studies which have been conducted in direct support of the Southern Ontario Multimodal Passenger Studies project. It should be noted that these reports are essentially working papers describing the various analyses carried out and the methodologies applied during the study process. Most of these reports contain information collected at an earlier stage of the Study and, hence, were written without the full benefit from insights gained during the later phases of the study. Occasionally, data and conclusions from these earlier, technical background papers were no longer found valid and have not been integrated into the Southern Ontario Multimodal Passenger Studies report.

All of these reports are available for reference at the information offices of Transport Canada and the Ministry of Transportation and Communications of Ontario.

I. GENERAL

1. Transport Canada and Ministry of Transportation and Communications, Ontario, SOMPS Task 1 Report: An Inventory of Existing and Forecast Travel Demand, September 1978.

2. Transport Canada, Strategic Planning Group, Estimation of Fuel Conspumtion for Preliminary SOMPS Supply Strategies, August 1979.

3. Transport Canada, Strategic Planning Group, Population and Income, Estimates for 1976 and Forecasts to 1991, Selected Provinces, Census Metropolitan Areas and Census Agglomerations, December 1978.

4. Transport Canada, Strategic Planning Group, An Outline of PERAM Forecasts for Domestic Travel by Mode, January 1979.

5. Transport Canada, Strategic Planning Group, SOMPS, PERAM Simulation Forecasts: Toronto-Montreal, January 1979.

II. AIR

(All reports were prepared as part of the Southern Ontario/Montreal Air Transportation Study (SOMATS) by Transport Canada, Air Transportation Administration, September 1979. Report 3C is a joint TC/MTC report.)

1. Basic Assumptions and Supply Strategies.
   Appendices: 1 CTOL Shuttle TIA/Mirabel.
   2 Options Previously Examined and Eliminated.
   3 Development of London Airport as a Connecting Hub for Western Canada.

2. Demand Analysis, July 1978.

3. A) Development of Physical Solutions, October 1978.
   Appendices: 1 Expansion at TIA.
   2 Air Cargo Implications.

   B) Diversion of Charter Traffic from TIA Malton to Hamilton: Air Traffic Control Study.

   C) Airport Ground Access Study (Joint MTC/TC Report),
   Appendix 1 Toronto Internal Airport Distributor Road Concept, Position Paper.

   D) Revenue Analysis.

   E) Cost Recovery Analysis.

4. Area Airports Systems Analysis, Summary and Conclusions, (to be available October 1979).

5. Systems Analysis and Evaluation.

   Appendix 1 The Implications of Bilateral and Other International Agreements for the Management of Southern Ontario Traffic.

6. Requirement for Diversion of GA Traffic from TIA.

7. Runway System Macro Assessment.

8. A) STOL System Requirements.

   B) STOL Service in the Montreal Area Airports System, (to be available October 1979).

   C) Summary Report: STOL Service in the Montreal/ Southern Ontario Airport System, (to be available October 1979).

9. Ground Access Costs and Convenience Analysis.

10. Assessment of Direct Energy Implications of Passenger Diversion.

11. A) Macro Environmental Evaluation.

    B) Noise Impact Assessment, (to be available October 1979).

12. Summary, Origin & Destination Air Passenger Forecasts.

Appendices: A - Socio-Economic Inputs.
B - Recommended Range and Baseline Forecast for SOMPS/SOMATS.

III. RAIL

1. Transport Canada, Surface Transportation Administration, Railway Passenger Development Branch, SOMPS High Speed Rail Costing Study.

   A) High Speed SOMPS Passenger Train Operating Cost Estimation, March 1978.

   B) SOMPS, Capital Cost Estimation for High Speed Rail Lines, May 1978.

2. Transport Canada, Surface Transportation Administration, Railway Passenger Development Branch, High Speed Passenger Rail Options in the Southern Ontario Multimodal Passenger Study, Montreal/Ottawa/Toronto, - Summary of Phase 1 Studies -, December 1978.

IV. HIGHWAY

1. Transport Canada and Ministry of Transportation and Communications, Ontario, SOMPS Supply Strategies, Evaluation of a High Speed Luxury Bus, September 1978.

   Appendix A - Cost Estimating Method.

2. Transport Canada and Ministry of Transportation and Communications, Ontario, SOMPS: Intercity Travel and the Automobile, September 1978.

IV. HIGHWAY

1. Transport Canada and Ministry of Transportation and Communications, Ontario, SOMPS Supply Strategies, Evaluation of a High Speed Luxury Bus, September 1978.

Appendix A - Cost Estimating Method.

2. Transport Canada and Ministry of Transportation and Communications, Ontario, SOMPS: Intercity Travel and the Automobile, September 1978.

AN INVENTORY OF DOCUMENTATION FROM STUDIES RELATED TO THE SOUTHERN ONTARIO MULTIMODAL PASSENGER TRANSPORTATION STUDIES

This inventory lists reports on passenger transportation which have been produced before or concurrent with the Southern Ontario Multimodal Passenger Studies. Information from the reports listed has served as background information and, in some instances, was used as direct input for S.O.M.P.S..

Some study reports were published in multi-volume series. These sub-reports are also listed here.

I. GENERAL

1. Canadian Transport Commission, Intercity Passenger Transport Study, September 1970.

2. Transport Canada, An Interim Report on Intercity Passenger Movement in Canada, June 1975.

3. Transport Canada, Report on June 1977 Travel Survey, November 1978.

II. AIR

1. Airport Inquiry Commission (Gibson Commission), Report upon certain matters in relation to the air transportation needs of the central Ontario market, 1974.

2. Transport Canada, Air Transportation Administration, Toronto Area Airports Project, Originating - Terminating Passenger Forecasts for the Toronto Airports System, 2 Volumes, March 1974.

   Vol. I - Main Report
   Vol. II - Appendices

3. Transport Canada, Air Transportation Administration, Toronto Area Airports Project, Updated Demand Forecasts for the Toronto Area Airports System, 4 Volumes, August 1975.

   Vol. I - Annual Passenger Cargo Forecasts
   Vol. II - Aircraft Movement Forecasts
   Vol. III - Peak Hour Forecasts
   Vol. IV - Minimum International Airport - 1980 Forecasts

4. Intergovernmental Staff Forum. Toronto Island Airport Study Programme: July 1976 - August 1977.

STUDY 1 - Local and Feeder Air Transportation Study STOL Air Transportation in Ontario

(Managed by M.T.C.)

STUDY 2 - General Aviation Demand and Evaluation of General Aviation Facilities in the Toronto Area

2A.1 A System Analysis and Demand Forecast of General Aviation in the Toronto Region

2A.2 Appendices

STUDY 3 - Alternative Aviation Uses for the Toronto Island Airport Site - Impact Studies

(Managed by M.O.T. with the cooperation of M.T.C.)

Reports:

3 Summary Report

3A Demand Forecasts

3A.1 Toronto Island Airport Forecasts of Passenger - Traffic and Aircraft Movements

3A.2 Appendices to above report

3B Air System Implications

3B.1 An Assessment of the Impact of Commercial STOL - Operations at Toronto Island Airport on CTOL - Operations at TIA Malton

3B.2 STOL Impact on Traffic Forecasts at TIA Malton

3B.3 An Assessment of the Impact of Commercial STOL operations at CFB Downsview on CTOL at TIA Malton

3B.4 Impact on Non-Aviation Uses of the Toronto Island Airport

3C Facility Requirements

3C.1 Inventory of Existing Facilities

3C.2 Facility Requirements General Aviation Activities

3C.3 Facility Requirements General Aviation Activity and STOL services

3D Physical Environment

3D.1 Noise Impact

3D.2 Air Quality Impact of the Toronto Island Airport on the Surrounding Urban Area

3D.3 Natural Environmental Appraisal

3D.4 Economic Considerations (Energy; Employment; Financial Performance; Passenger Characteristics).

STUDY 4A - Non-Aviation Uses Study - Background Report

4B - Non-Aviation Uses Study - Progress Report

4C - Non-Aviation Uses - Four Scenarios

(Managed by City of Toronto Planning Board with M.S.U.A.)

STUDY 5 - Alternate Channel Study

(Managed by Toronto Harbour Commission)

STUDY 6 - Access Alternatives

(Managed by Municipality of Metropolitan Toronto Planning Department)

STUDY 7 - Regional Planning Aspects of Possible Future Uses of the Toronto Island Airport Site

STUDY 8 - Alternative Ground Transportation Modes Study

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Additional Reports of Toronto Island Airport Study:

a) Summary of Alternative Scenarios, May 1977.

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c) Final Report on Public Participation, July 1977.

5. Ontario Ministry of Transport and Communications. Local and Feeder Air Transportation Policy and Planning Study. 5 Volumes.

Report I: Tasks 1 to 3, August 1975.

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The twelve tasks were:

1. Review of previous and current studies.
2. Review of previous and current regional development planning goals.
3. Documentation of existing commercial air services.
4. Local and feeder/commuter air service characteristics and critical planning factors.
5. Demand estimates and development of network alternatives.
6. Implementation alternatives and costs.
7. Documentation of infrastructure deficiencies and requirements.
8. Present general aviation activity.

9. Public attitudes and perceived social impact associated with upgrading intercity transportation.

10. The role of aviation in local economic development and its relation to the attainment of regional planning goals.

11. Regulatory and jurisdictional considerations.

12. Public/private sector roles.

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Summary Documents

- Volume I - Executive Summary - October 1978.

- Volume II - Summary of Study Results - June 1977.

Supporting Documents

Departure Delay Study - April 1977

Runway System Capacity Study - April 1977

Airspace Utilization Study - Phase 1:

- Study Design and Data Collection Methodology January 1977.

- Preliminary Identification of Potential Improvements in the Airspace/Airport System Operation - February 1977.

- Technical Report

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Hamilton

a) Forecasts of Total Demand and Airport Patronage. April 1973.

b) Site Location and Area Criteria. February 1974.

c) Cargo Forecasts. August 1974.

d) Program Outline. December 1974.

e) Aircraft Movement Forecasts. April 1975.

f) Inventory of Existing Facilities at Hamilton Airport. June 1975.

g) Wind Speed and Direction Study at Hamilton Airport. June 1975.

h) Hamilton Airport Employment Forecasts. June 1975.

i) Existing and Proposed Regional Planning Policies - Stage 1. August 1975.

j) Hamilton Airport Runway Utilization and Mix. September 1975.

k) Forecasts of Peak Hour Activities at Hamilton Airport. October 1975.

l) Hamilton Airport Site Selection - Stage II and III. October 1975.

m) An Evaluation of the Impacts of STOL and LRC on Hamilton and Windsor Airports. November 1976.

n) Hamilton Airport - Airspace Considerations. March 1976.

o) Hamilton Airport: Air Quality Study. March 1976.

p) Comparative Environmental Assessment Study of Alternate Airport Sites at Hamilton. March 1976.

q) Hamilton Airport: Agricultural Study. April 1976.

r) Heavy Civil Engineering and Utilities Evaluation of the Existing and Alternate Sites: Hamilton Airport April 1976.

s) Hamilton Airport: Socio-Economic Impact Study Supplementary Material - On-Site Inventory. May 1976.

t) Hamilton Airport Study Program: Ground Transportation Study. May 1976.

u) Hamilton Airport: Initial Land Use Concepts for the Existing and Alternate Sites. October, 1976.

v) Hamilton: Existing Airport Capacity. October 1976.

w) Hamilton Airport: Socio-Economic Impact Study. January 1977.

x) Hamilton Airport Study Program: Evaluation Methodology Report. February 1977.

y) Hamilton Airport Study Program: Summary Report. February 1977.

z) Hamilton Airport: Executive Summary. May 1977.

A. Hamilton Airport Study: Technical Recommendations. December 1977.

Windsor

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k) Initial Land Use Concept for Representative Alternative Site. August 1975.

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III. SURFACE

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The Future of the Automobile in Canada (Summary Report).

Working Papers:

1. Cities and Transport in Evolution.

2. Perspectives on the Evolution of the Automobile in Canada.

3. Etude sur le rôle de l'automobile: Prévisions socio-économiques.

4. Social Change and the Automobile.

5. Psychological Variables Related to Automobile Ownership and Use.

6. Social Equity and the Automobile.

7. An Inventory of the Automobile Non-User in Canada.

8. Urban and Regional Development Factors Affecting the Role of the Automobile.

9. The Expanding City.

10. The Potential for Telecommunications as a Travel Substitute.

11. Competing Travel Modes.

12. Canadian Energy Scenarios: 1975 to 2010.

13. Changing Patterns in the Use of Mineral Materials in the Automotive Industry.

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15. An Examination of the Potential for Innovative Automobile Power Trains.

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23. Trends in Use of Energy in Transportation.

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